PETROLEUM PROCESSING

VOLUME 3, NUMBER 3 MARCH, 1948

TECHNOLOGY DEPARTMENT

Steel Fire Walls Gain Needed Space

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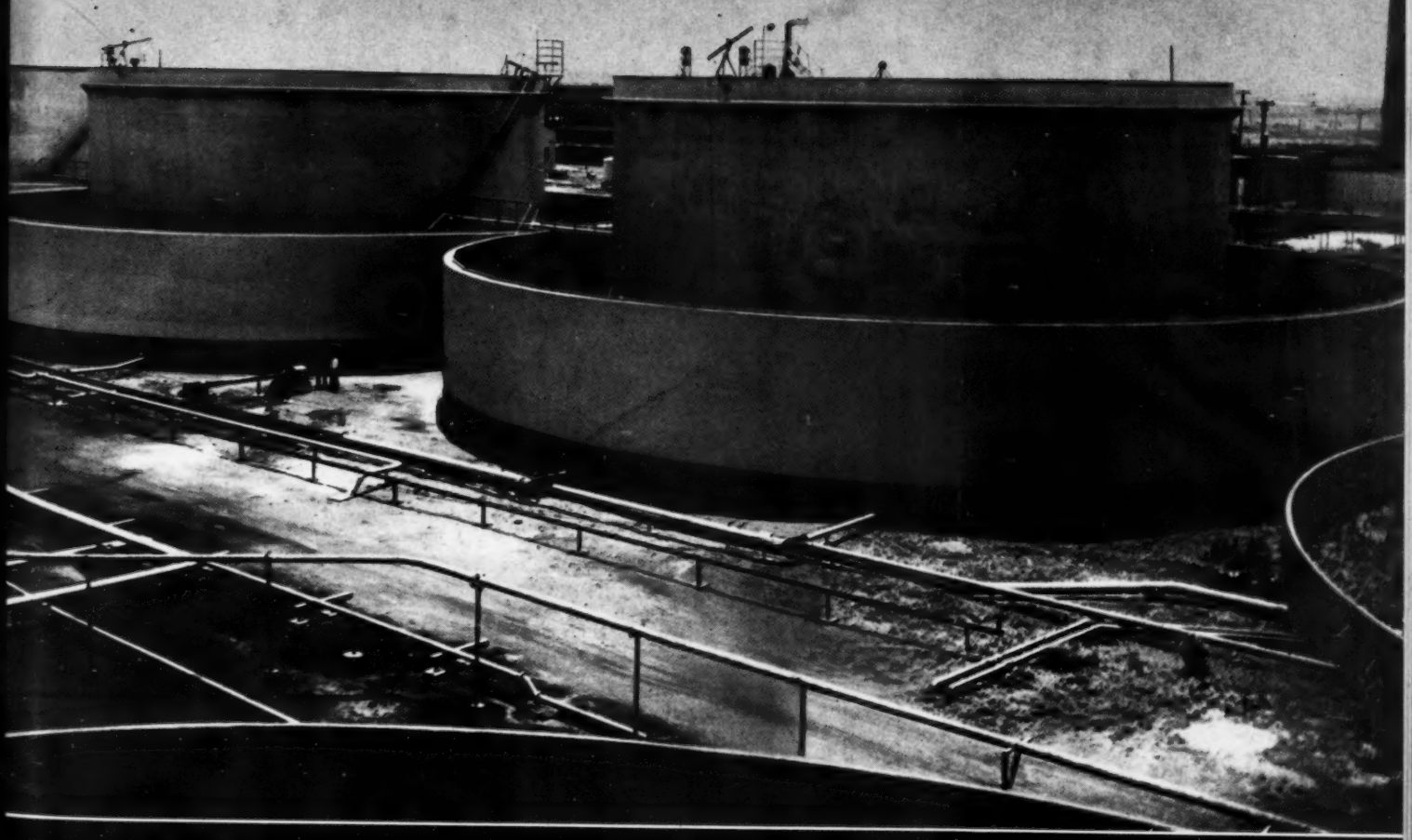
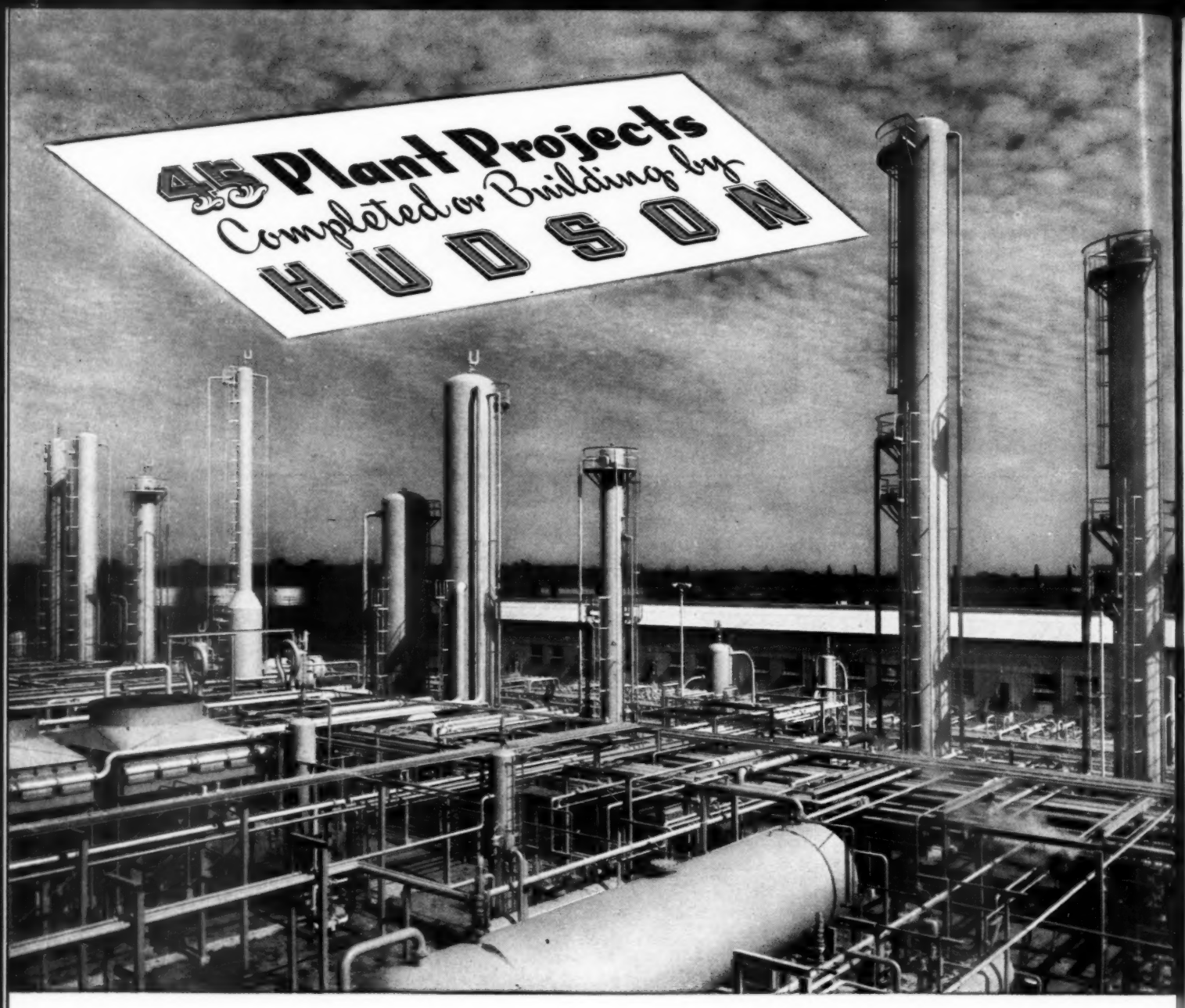
DETROIT



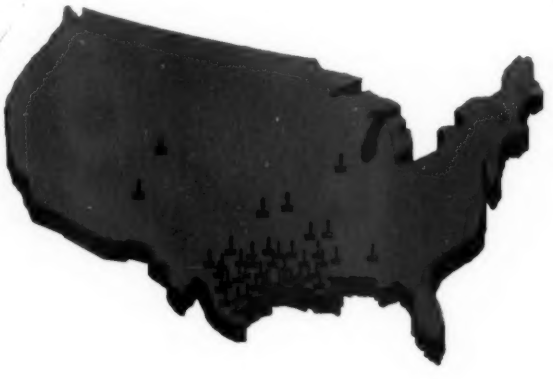
FORMERLY MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS



Pictured above is the first gas processing plant to operate in Mississippi, designed and constructed by HUDSON for the operators in the Cranfield Field of Adams County.

Experience

The experience of the HUDSON organization in designing and building complete plants for gas processing results in: ***Advanced Process Design . . . Speed in Design, Procurement and Construction . . . Minimum Overall Cost of Processing . . . and*** **Satisfied Clients.**



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ENGINEERING CORPORATION
FAIRVIEW STATION HOUSTON, TEXAS

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DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS
REACTIONATION UNITS • CRUDE TOPPING UNITS • PRESSURE
MAINTENANCE PLANTS • HYDROGEN SULPHIDE REMOVAL
PLANTS • ATMOSPHERIC AND VACUUM DISTILLATION UNITS

Knock ratings obtained with this modified CFR single-cylinder research engine having a special "bled" intake manifold indicate fuel antiknock performance under conditions of partial fuel vaporization which occur in automobile engines during acceleration at full throttle and low speeds.

Putting tomorrow's fuels through their paces

FUELS AND ENGINES are interdependent. Progress in one must be coordinated with progress in the other. New fuels must be evaluated in engines under conditions representative of those in which they ultimately will be used.

That is why the Ethyl Laboratories carry on research on possible future fuels in various special engines, such as the one illustrated above. In this single-cylinder engine it is possible to bleed off the heavier fuel components as they are separated from the more volatile portions by the manifold, in order to determine the antiknock quality of that part of the fuel which actually reaches the "lean" cylinders of multi-cylinder engines during acceleration at low speed and wide-open throttle. Such conditions exist during a very important part of the operation of automotive engines, with the result that distribution of the different fractions of gasoline is not uniform among the engine cylinders.

In cooperative programs with oil companies, the Ethyl Corporation has operated single-cylinder and multi-cylinder engines in its laboratories for thousands of hours, and has operated vehicles on the road for millions of miles, in order to study fuel performance under the widest possible range of representative conditions.

Utilizing its more than twenty years of experience and close association with technologists of the oil and automotive industries, Ethyl Corporation's cooperative research and service activities involve both the investigation of current problems and the development of fuels and antiknocks for the future.

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research laboratories

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40 Leonard workmen turn around Leonard TCC unit in 10½ days with only 4557 man-hours!

After a highly successful initial run of 222 days, Leonard Refineries Inc. shut down its small-scale T C C cat cracker. The unit, which had attained an on-stream efficiency of 96.4 per cent, was completely inspected from the charge pump to the final stabilizer in the gas plant section.

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The excellent condition of the reactor, regeneration kiln and split-bucket elevator are evidenced by the fact that only 425 man-hours were required for the inspection of the entire catalytic section.

Measurements indicated no loss of metal from the reactor shell or internal metal elements from either erosion or corrosion, despite the fact that the unit processed a stock of relatively high sulphur content.

Thus, again, the sound design and construction of T C C pays off in high on-stream efficiency, short down-time, greater product recovery.

HOUDRY CATALYTIC PROCESSES
SERVING THE PROGRESSIVE PETROLEUM INDUSTRY

HOUDRY PROCESS CORPORATION, PHILADELPHIA 2, PA.

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VOLUME 3
NUMBER 3
MARCH, 1948
PUBLISHED
MONTHLY

PETROLEUM PROCESSING

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NATIONAL PETROLEUM NEWS
OILGRAM NEWS
OILGRAM PRICES
PLATT'S OIL PRICE HANDBOOK

Covering the Management, Design, Operation, Equipment, Products of Plants Processing Crude Oil and Natural Gas into Fuels, Lubricants, Chemicals

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for March, 1948

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COVER STORY

STAFF: Warren C. Platt, Publisher; V. B. Guthrie, Editor; A. E. Kraft, Treasurer; D. P. Thornton, Jr., Assistant Editor; William F. Bland, Engineering Editor; William C. Uhl, Equipment Editor.
OFFICE: 1213 West 3rd St., Cleveland 13, Ohio, telephone CHerry 7672; Editorial Bureaus—50 West 50th St., New York 20, N. Y.; 1046 National Press Bldg., Washington 4, D. C.; 59 East Van Buren St., Chicago 5, Ill.; 904 World Bldg., Tulsa 3, Okla.

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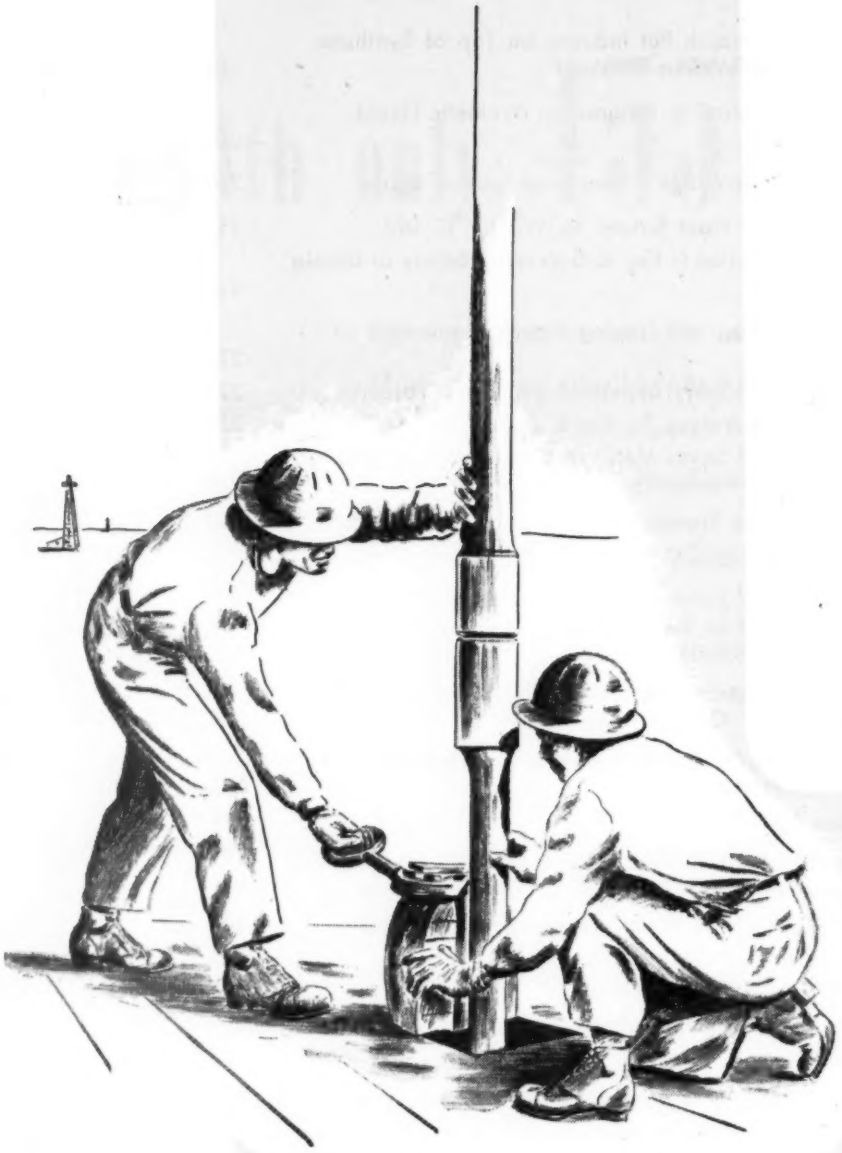
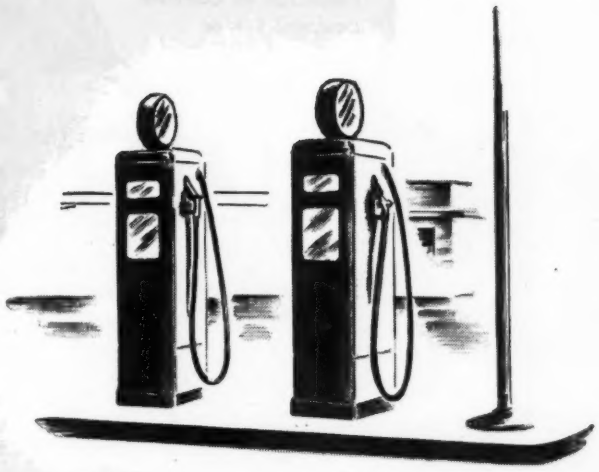


IT'S A LONG WAY FROM WELL TO PUMP



From production to refining to marketing is never a short haul when time is considered. Today, with consumption of all petroleum products at a new high, it's important that this time from well to pump be held to a minimum.

In refining, for instance, without efficiency of process plus efficiency of equipment, there's danger of time lost that puts marketing . . . and the industry as a whole . . . on the spot. Helping eliminate this lost time, while producing a better quality product more economically, is the purpose of Universal's research, engineering, processes and service.

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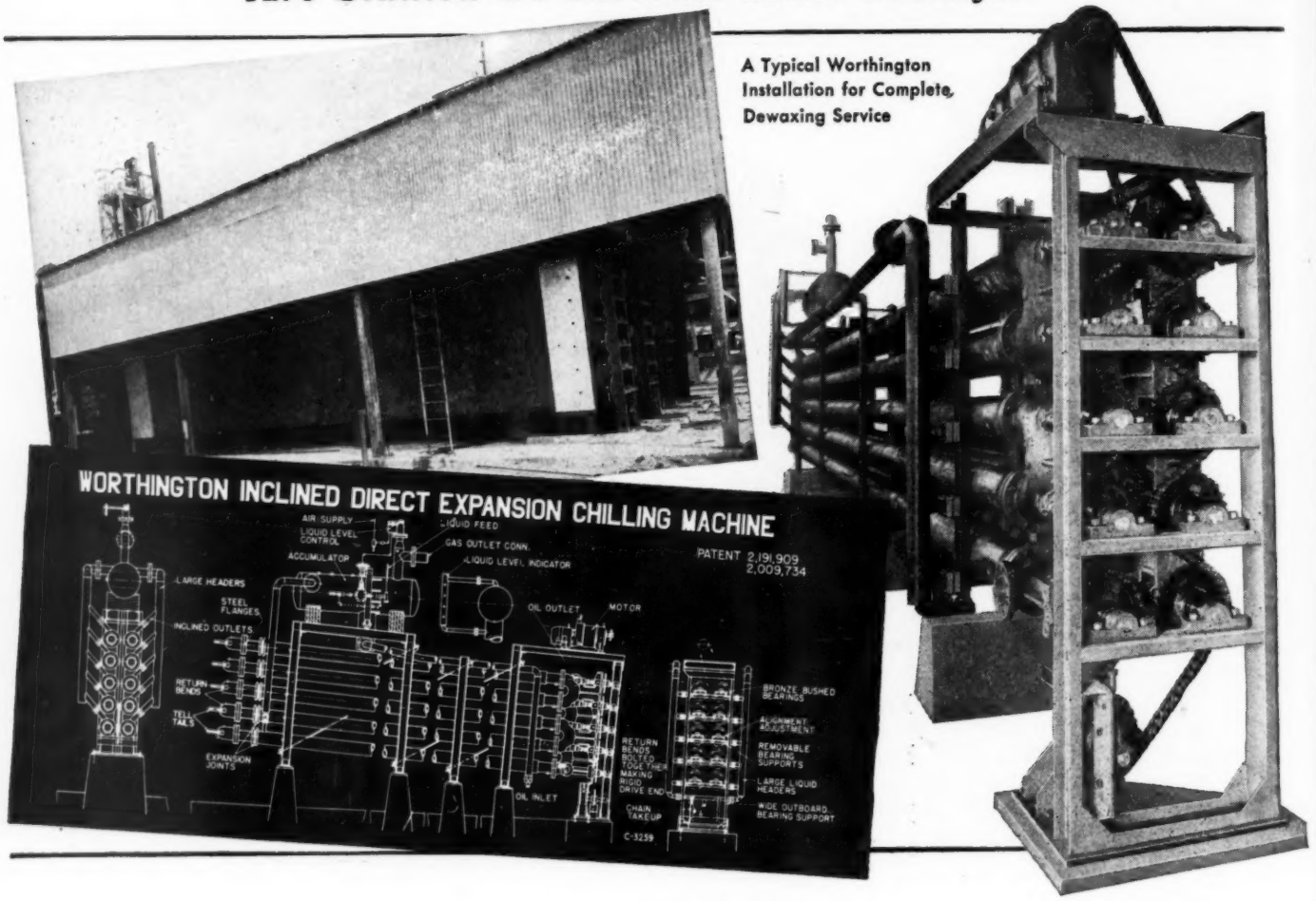

A Typical Worthington Installation for Complete Dewaxing Service

The *inclined* position of Worthington Double-Pipe Chilling Machines — with vapor outlet above liquid inlet — is an important Worthington exclusive!

WHAT "SLANTING" DOES

All unused liquid refrigerant is swept back to the accumulator by the vapor's upward flow. "Flash" gas returns directly to the refrigerating unit — only liquid refrigerant reaches the chilling section. Spring-loaded scrapers, inside the inner pipes, remove all heat-retarding crystals, further increase thermal efficiency.

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Except for their level setting and a difference in applying the refrigerant, Worthington Double-Pipe Exchangers have the same general construction —featuring safety-scraper drive; easily removable, pressure-lubricated drive shaft and improved chain-and-sprocket main drive.

Learn why so many complete dewaxing plants are using these better designed, better performing Chillers and Exchangers.

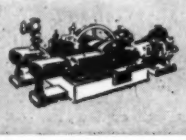
Write for Bulletin C-110-B-15, with the details that prove *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Harrison, New Jersey.*

WORTHINGTON

A7-11

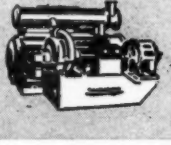
FIVE MORE REASONS WHY WORTHINGTON LEADS IN INDUSTRIAL REFRIGERATION

Horizontal compressors for all types of refrigerants

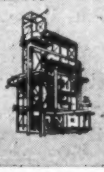


Shell and tube refrigerating equipment

Centrifugal compressors



Absorption refrigerating machines



Chilling machines and exchangers

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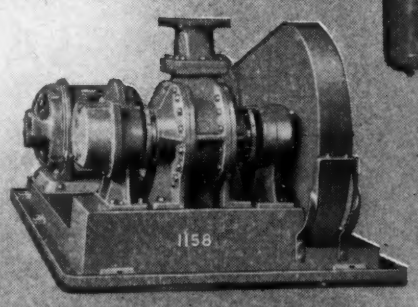
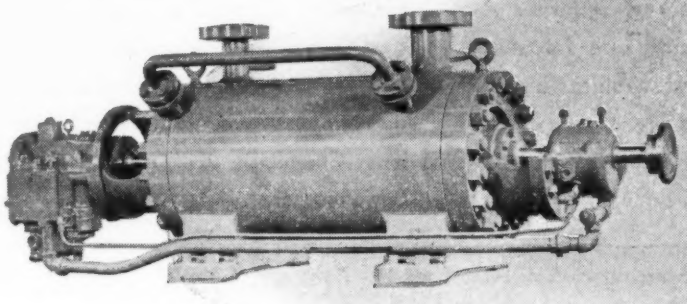
CENTRIFUGAL PUMPS	Pacific
ROTARY POSITIVE BLOWERS	Roots-Connersville
RECIPROCATING GAS COMPRESSORS	Clark
STORAGE TANKS	Stacey Bros.
ENGINES	Clark
EXHAUSTERS	Roots-Connersville
INERT GAS GENERATORS	Roots-Connersville

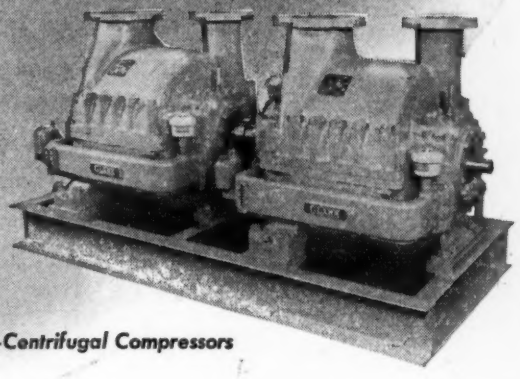
PACIFIC—*Vertical Types*



ROOTS-CONNERSVILLE
—*Cycloidal Rotary Pump*



PACIFIC—*Centrifugal Pumps*



CLARK—*Centrifugal Compressors*

You can get all transfer equipment—with variations to fit your peculiar problems—from the family of Dresser Industries. The *family* angle is important. The several operating member companies do specialize—Clark Bros. in reciprocating compressors and engines; Roots-Connersville in Rotary Positive Blowers; Pacific Pumps in centrifugal hot oil pumps; and Roots has still a different centrifugal. But each is engineered to operate with the others for best efficiency.

But—because Dresser Industries is the only company doing an over-all engineering job for the oil industry, you can get, from any one of these operating companies, unprejudiced advice regarding types of equipment which it, itself, does not make, but which you will find made by some one of the Dresser Industries. There is no need to compromise with engineering for the sake of a sale.

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ROOTS-CONNERSVILLE Blower Corp.
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STACEY BROS. Gas Construction Company
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Stacey-Dresser Engineering Division
Cleveland, Ohio

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Approximate Solubility* of Du Pont Oil Colors at 60° F., Grams per Gallon

	Du Pont Oil Yellow N	Du Pont Oil Orange	Du Pont Oil Red	Du Pont Oil Blue
Straight Run Gasoline	27	24	12	2.3
Aviation Gasoline	24	25	6	1.5
Thermal-Cracked Gasoline ...	42	44	13	4.2
Catalytic-Cracked Gasoline ..	72	66	23	6.8
Benzene	832	242	114	114

**These data are intended only as a guide since hydrocarbon structure has a pronounced effect on solubility. For example, two thermally-cracked fuels may have widely different solvency because of differences in the crude source, severity of cracking, etc.*

PETROLEUM CHEMICALS

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...THROUGH CHEMISTRY

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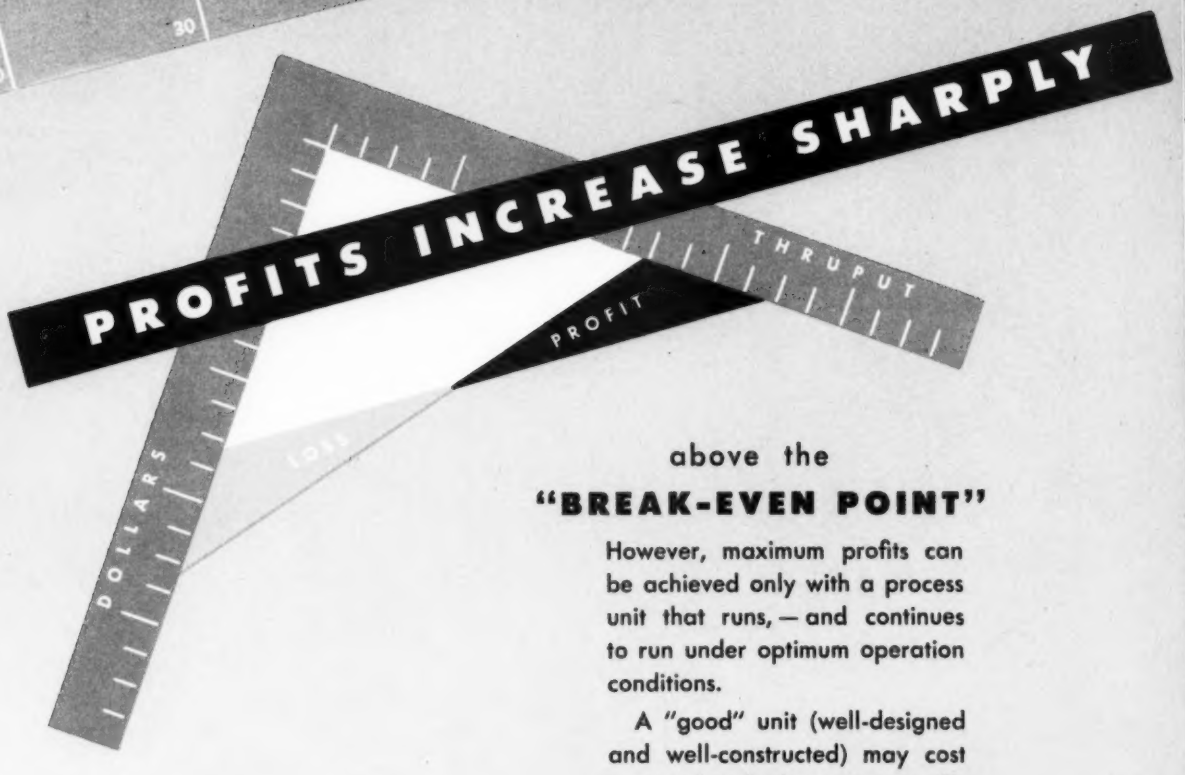

above the

"BREAK-EVEN POINT"

However, maximum profits can be achieved only with a process unit that runs, — and continues to run under optimum operation conditions.

A "good" unit (well-designed and well-constructed) may cost more — but the increment usually represents inexpensive profit insurance.

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3½ years

Designed and constructed by Foster Wheeler for the Bayway Refinery of the Standard Oil Company of New Jersey.

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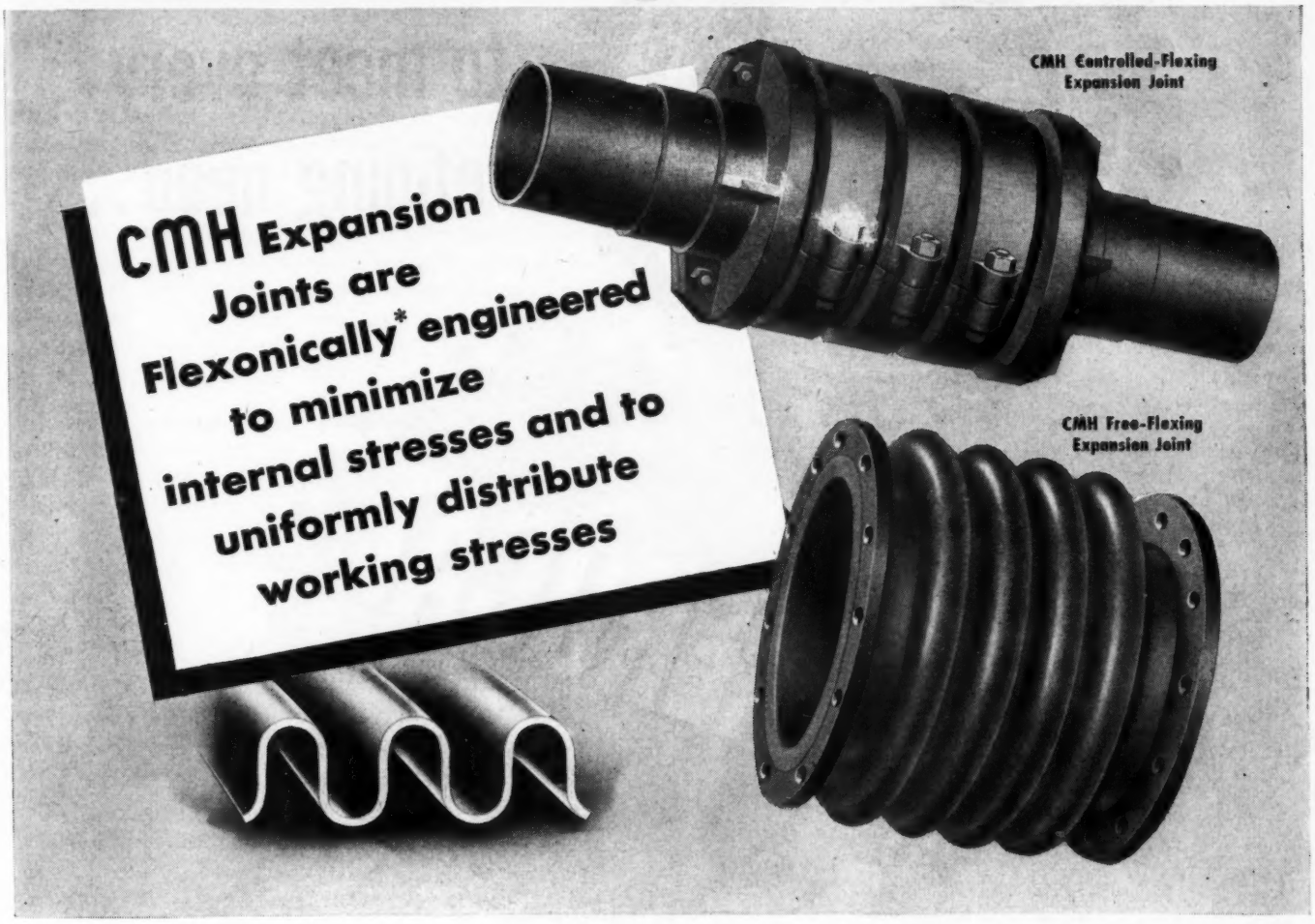
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What's Happening!

MARCH 1
1948

Summary of Current News Developments Concerning Oil Men

SYNTHETICS

A gigantic synthetic fuel industry capable of producing 2 million b/d of liquid fuels is advocated by Interior Secretary Krug. Establishment of such a capacity, Krug says, would require an expenditure of $9-billion, along with 16 million tons of steel.

Reasons for Krug's proposal are increasing domestic and world-wide demand for petroleum at same time U. S. production capacity is decreasing. "It is clear now," says Krug, "that the U. S. cannot rely exclusively on petroleum to supply all future requirements for liquid fuels and related products."

Industry reaction was quick—and tart. Bruce K. Brown, vice president of Indiana Standard and chairman of the Military Petroleum Advisory Committee, was first challenger. Appearing before House Armed Services Subcommittee, Brown stated "I am convinced that we can get more oil—quicker—by making steel available to the oil industry than by any other method."

Even the starting of a few large-scale synthetic plants as advocated by Krug, he said, "would, because of their enormous requirements for steel, cut down the immediate availability of oil by depriving the industry of steel it needs this year and next year."

Neither economically practical nor desirable now was the opinion expressed by P. C. Keith, president of Hydrocarbon Research, with respect to the government's proposed coal hydrogenation plants. Instead, he suggests (1) gasification of coal to relieve heating oil demand and (2) synthesis of 650,000 b/d of fuel oil and gasoline from 2 to 2.5 trillion cu. ft. of natural gas to supply requirements in excess of "natural" production.

Immediate construction of three plants of commercial size—oil shale, coal hydrogenation, gas synthesis—is part of Krug's plan. Each plant would have 10,000 b/d capacity, and total cost would be $300- to $400-million. Bill authorizing such a program was introduced in Congress Feb. 20—H.R. 5475.

Although Krug emphasized repeatedly in appearance before House Public Lands Committee Feb. 9 that he doesn't feel that government should get into commercial production of synthetics, he warned that if private capital doesn't develop a commercial synthetic liquid fuels industry, the government would take over the job. Creation of such an industry is "so important," he said, that "if government has to do all of it, it should do it."

Bureau's research program on synthetics was virtually assured of more money and time with passage by both House and Senate of bills to add $30-million to the authorized appropriation for study into methods of producing synthetic liquid fuels. Bills also extend the program an additional three years—to June 30, 1952. (More details, pp. 207, 208, this issue.)

• • •

CONSTRUCTION, EXPANSION

Rock Island Refining Corp. will install a 5000 b/d Fluid catalytic cracking unit at its Rock Island, Ind., refinery. Universal Oil Products Co. will design and engineer the unit.

Humble Oil & Refining Co. has announced plans for expanding its Baytown refinery with a $19-million program, to be started this year. Chief item is a new 45,000 b/d pipe still which will expand present capacity by nearly 20%.

Witco Hydrocarbon Corp. has been organized by Witco Chemical Co. to process 15 million cu. ft. of natural gas daily to produce 2000 b/d of gasoline, butane and propane, as well as channel black.

Cities Service Oil Co. plans a $2,500,000 plant to compound more than 16 million gals. of lubricating oil and to manufacture between 5 and 7 million lbs. of grease annually. Ground for the project has been purchased in metropolitan Chicago, 42 acres on the east side of Cicero Ave. abutting the Sanitary Canal. Plans call for completing the plant by mid-1949. Blending stocks will be obtained from the new solvent lube oil plant now under construction at Lake Charles, La., by Citcon Oil Corp., owned by Cities Service and Continental Oil Corp.

Gulf Oil Corp. has been reported to have long range plans for a $40-million refinery on Staten Island in New York Harbor, although no confirmation has been received from the company. Proposed site is said to be on land already owned by Gulf.

• • •

LABOR

Hourly wages increase of 30c will be demanded by the Oil Workers International Union (CIO). The decision to seek the increase, announced Feb. 11, was approved by the union's National Policy Committee at its recent meeting in Ft. Worth, and was taken, the committee said, "to protect members against the ravages of inflation."

Payment of the increase from profits apparently will be the theme song OWIU will use in pushing its

Information on these pages is obtained through the nation-wide news coverage services of PLATT'S OILGRAM NEWS

demands. An official statement issued at the time the 30c demand action was announced said in part that the wage advance could "easily be granted from a thin slice" of profits without "the slightest increase in the price of gasoline or fuel oil."

Strikes to win the increase may be resorted to, OWIU president O. A. Knight has stated. In a speech made Jan. 29 before some 500 members of Local 227 in Houston, Knight said the union will strike if necessary to win its campaign for a third round of postwar wage hikes.

An 8c per hour raise has been granted workers at the Port Arthur refinery of Gulf Oil Corp. This blanket increase is retroactive to Jan. 1 and is added to the basic wage rates; it is not a cost of living bonus. The increase was granted without any extension of present union contract with Gulf, which expires in May.

• • •

SUPPLY AND DEMAND

Crude production reached a new peak during the week ending Feb. 14—5,347,175 b/d. That was the third new production record in five weeks. Production during same period a year ago was 4,757,650 b/d.

Crude runs to stills, however, fell off from their all-time record peak of 5,637,000 b/d for week ending Jan. 3, 99.4% capacity. Low point was 5,348,000 b/d for week ending Feb. 7, reflecting in part, at least, effect of cold wave then prevalent and which stopped barge shipments of crude to some refineries. Crude runs during same period last year were 4,788,000 b/d.

Total motor vehicle registrations in 1947, according to R. L. Polk & Co., automotive industry statisticians, rose to 33,453,776, including 2 million additional passenger cars—which explains in part the increasing gasoline demand.

Diesel locomotive horsepower, another large factor in petroleum demand picture, will be trebled by 1953, according to a prediction by the Diesel Engine Manufacturers Assn. Present diesel locomotives in service today represent 7,166,436 h.p.—and more than twice that amount, 15,000,000 h.p., is expected to be added in next five years.

• • •

EARNINGS

Nearly 2/3 of net earnings by 30 leading oil companies were retained in 1947 to finance capital expenditures of $1,950,000,000, according to Joseph E. Pogue, vice president of Chase National Bank.

Frontier Refining Co. proudly announced Feb. 6 that its six-month's net profit for period ending Nov. 30, 1947, was $270,969.62—275% over earnings reported for corresponding period in 1946. Frontier's report characterized as "fuzzy thinking" the idea held by some that company earnings reports should be toned down, thereby implying that profits are really a minor motive for business enterprise. "The great bulk of American men and women," the company's statement said, "admire a successful profitable business. They believe wholeheartedly in the profit motive."

Sun Oil Co. reported net earnings of $24,339,912 for 1947, compared with total of $14,726,551 in 1946. In addition to normal reserves for depreciation, Sun last year set aside an extra $4,800,000 to offset increased replacement costs.

• • •

MISCELLANY

"Two very peculiar ideas" appear to possess the public according to Rep. Heselton (R., Mass.)—one is that premium gasoline is better than regular and the other that oil should be changed every 1000 miles. He says industry sources have informed him that premium is "no better than regular for ordinary driving and actually worse on hills;" also, that oil change once in 5000 miles or even more should be often enough. He wants military to advise Congress on the questions.

Octane ratings continue to climb, according to latest motor fuels survey of Bureau of Mines. Premium and regular fuels averaged 79.2 and 75.1, respectively, in summer of 1947, compared to 78.3 and 74.4, respectively, in 1946.

Gum gummed the works for about 250 Detroit motorists last month. The trouble started after a quantity of aromatic distillate, which analysis later showed to have a gum content of 480 mg. per 100 ml., was used for blending purposes in motor fuel. The distillate, a by-product from a chemical firm making glycol, had been sold for what it was to an oil distributing company, according to Detroit city officials. It was then, however, sold as petroleum naphtha to two men connected with a small independent refining company. Unwary motorists who got "stuck" had repair bills as high as $170-$180.

• • •

TRANSITION

Standard Oil Co. of New Jersey passed out of existence last month—but in name only. Henceforth the concern will be known as Esso Standard Oil Co. Standard Oil Co. of N. J. has frequently been confused in the past with its parent company, Standard Oil Co. (N. J.), a confusion which the new name will help eliminate.

Pana Refining Co. sold its 4000 b/d refinery at Pana, Ill., to Illinois Farm Supply Co., oil co-op affiliate of Illinois Agricultural Assn.

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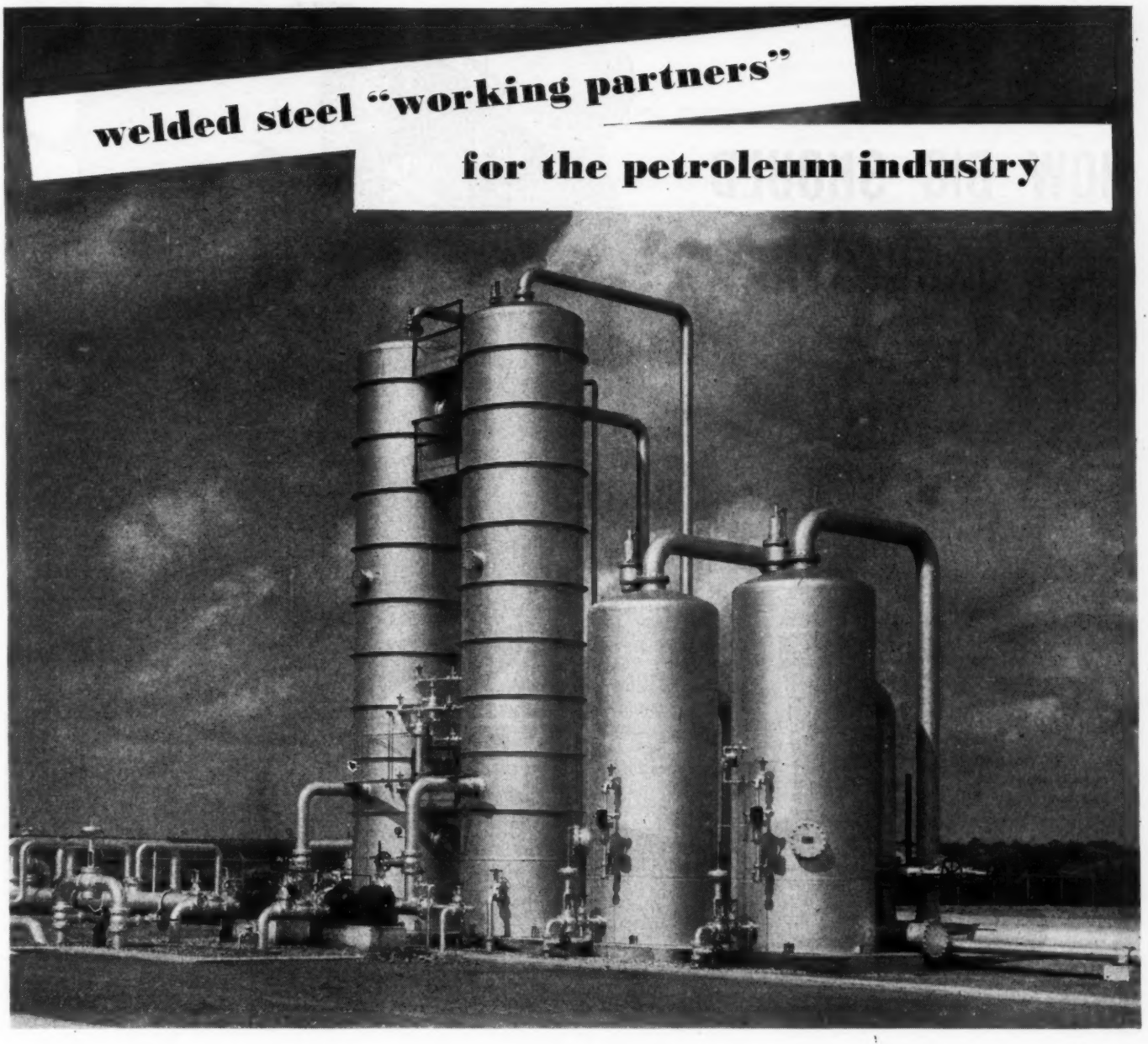

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TOMORROW

... IN PETROLEUM TECHNOLOGY

Current technological and economic developments are discussed in the light of their future bearing on petroleum refining operations. Topics include:

- **Methanol production from natural gas increasing.**
- **Coal tar losing to petroleum as source of chemicals.**
- **More technical data released on Synthine process.**
- **Synthetic detergents continue to attract attention.**

Methanol-From-Gas Increasing in Volume

CHEMICAL TRADE MISNOMERS are always the subjects for mirth, but often at the expense (financial) of some branch of the industry involved. No better example could be cited that methanol, still commonly called "wood alcohol" although less than 10% of its present production comes from wood. The synthesis of methanol has taken over this field so completely that the producers of this substance by the destructive distillation of wood have not increased their output in 20 years and have had to fall back upon the "desirable impurities" (for denaturing ethanol) as the sole economic prop for their continued existence.

Two very recent articles(1), (2) have covered this subject in such detail that any lengthy discussion here would be unwarranted. As Williams points out, however, it is highly significant to note that, although as recently as 1946 "71% of the carbon monoxide used for methanol production was obtained from coal or coke, in 1948 77% of this raw material will be derived from natural gas."

Production of synthetic methanol in 1946 totaled 74,000,000 gals.; 80,000,000 gals. were produced in 1947 (plant capacity at the end of the year, 84,000,000 gals. per year); and Williams estimates that 110,000,000 gals. will be produced in 1948. "In 1949, capacity will be about 138,000,000 gals. Further expansion is probable up to 150,000,000 gals. if and when Hayden Chemical Co. decides to operate its Morgantown plant."(1)

At present, two companies, du Pont and Carbide and Carbon, "possess 90% of the country's operating synthetic methanol capacity"; other producers include the Celanese Corp., Cities Service, and Commercial Solvents. The latter company is expected to begin operation of its new plant at Sterlington, La., early in April; du Pont "has started partial operation of its natural gas synthesis venture at Sabine River, Texas"(2); and the Solvay Process Corp. (at South Point, Ohio) was scheduled to start operation in February of its converted wartime ammonia plant. The Spencer Chemical Co. is also converting a wartime ammonia plant at Military, Kansas. This plant, incidentally, will use natural gas, while Solvay's will employ coke as raw material. Another new producer the Mc Carthy Chemical Co., is scheduled to enter the field this year.

"For competitive reasons, and also due to the world's urgent need for nitrogen fertilizer, there is no cause to examine the position of (other) government built ammonia plants,"(1) at least for the present. "The only possible exception is the case of the du Pont-built and (postwar) Heyden-operated plant at Morgantown, W. Va." This plant could actually produce 70,000,000-80,000,000 gals. of methanol per year, but probably will never be operated at more than a fraction of this rate.

Nearly 80% of all the methanol produced is consumed in formaldehyde synthesis (chiefly for plastics) and used as an antifreeze and both of these uses are expected to increase. It is interesting and important to note that, although methanol synthesis is really a high-pressure variation of the Synthine (Fischer-Tropsch) process, very little methanol will be produced as a by-product from synthine plants under construction in Texas and Kansas, since the process variants to be used are deliberately not "conducive to the production of single-carbon-atom compounds."(1) Methanol prices, over the years, have declined steadily, although a sharp increase (10c per gal.) was registered in 1947, chiefly because of heavy demands.

While natural gas is now recognized as the least expensive raw material for methanol synthesis and demand will probably exceed supply for the next year or so, it seems unlikely that many additional petroleum companies will decide to enter this field in the near future. Projected capacity appears quite capable of taking care of potential heavy demands, and only some unusual combination of circumstances, such as the desire and ability to produce its own antifreeze, should inspire any new petroleum company to erect a plant.

More Technical Data On Synthine Process

WHAT with the political and economic furor now raging on the subject of synthetic liquid fuel plants and the necessity for any such program as the 2,000,000 b/d proposal urged by Secretary of the Interior Krug, it would be all too easy to miss the fact that more technical information is becoming available on the processes in question, particularly the Synthine process.

While this is not a book review section, it is not amiss to call attention here to the publication last month of the first book devoted to this process.(3) As interestingly put in the foreword by Dr. H. H. Storch of the Bureau of Mines, present knowledge on this process is like the foundation and framework of a building; the future design is indicated, but much work remains to be done. The book in question is intended as a summary of what is known and a guide to existing information.

German technology is included in the discussion of the various phases of the process, and three appendixes

Annual Index Ready

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(1) Williams, A. A., "Methanol Industry Makes Plans for the Future," *Chemical Engineering* 55, No. 1, 110-13 (1948).

(2) Stenerson, H., "Behind the Markets (Methanol)," *Chemical and Engineering News* 26, No. 5, 350 (1948).

(3) Weil, B. H. and Lane, J. C., *Synthetic Petroleum from the Synthine Process*, Remsen Press (Brooklyn), 1948.

—on patents, government-issued reports, and additional references—supplement the several hundred sources listed in chapter bibliographies. As pointed out in a detailed section on "Basic Economics," there appears to be no doubt of the economic as well as technical merits of the Synthine process.

No book can be more up to date than the day it was sent to the printer, however, so that it is not surprising that some valuable additional information is contained in a very recent article on this subject.(4)

Many details and discussions of pertinent factors are included in this article. Mention is also made of the 320,000 lbs. per day of water-soluble oxygenated chemicals and 100,000 lbs. per day of oil-soluble chemicals which will be potentially available; the probable economic impact of these chemicals incidentally, has been discussed in detail in a recent paper.(5) It certainly does appear that much is known about the Synthine process, but it is equally clear that much basic data must still be obtained before the mechanisms of the process become perfectly clear. Such needed research and commercial operations will apparently be conducted simultaneously in the next few years.

Coal Tar Losing Out As Source of Chemicals

"THE day of industrial aromatics based exclusively on the by-products of coal carbonization is coming to a close . . . Petroleum raw materials will eventually be the principal base."(6) When such a statement is made by an eminent chemical engineering economist, it can be readily accepted by those who have long held the same opinion, based on statistics and market trends.

Little need be said here by way of elaboration. Toluene is already very much of a petroleum chemical; naphthalene from coal tar of necessity is being supplemented with petroleum ortho-xylene for the production of phthalic anhydride; "benzene is today almost in a position of balance between production and demand," for the first time in history, and rising demands forecast the need for additional production from petroleum.

As regards benzene, Weiss(6) gives some particularly interesting figures. In 1947, the potential supply from coal-tar "light oil" was about 1,200,000,000 lbs., of which about 400,000,000 lbs. were used for "aniline, maleic anhydride, dichlorobenzenes, monochlorobenzene (other than phenol and aniline), nitrobenzene (other than aniline), diphenyl, and a great diversity of miscellaneous chemicals and special solvent uses . . . These uses are not very sensitive to price changes and will absorb considerable advances so that they will take benzene in preference to the other lines of use."

The remaining 800,000,000 lbs. of benzene was used about as follows:

	Benzene used (Lbs.)
Phenol	235,000,000
Styrene	280,000,000
Nylon	125,000,000
Detergents	50,000,000
	690,000,000

"The apparent excess of about 110,000,000 lbs. (15,000,000 gals.) was partly, at least, taken up by exports as well as by a certain amount of stockpiling,"(3) plus very slight use as "motor benzol." Since phenol capacity will require about 350,000,000 lbs. of benzene in 1949, output of maleic anhydride is rising sharply and will require 60,000,000 lbs. of benzene in 1948, and styrene capacity is around 550,000,000 lbs. higher than the above figure, future benzene demands will be of record proportions.

In addition to coke oven benzene, it is true that 180,000,000 lbs. of benzene per year (25,000,000 gals.) "may be expected from the distillation of coal tar and water gas tar as well as from certain petroleum cracking operations in California. This will not be enough to balance all other uses of benzene."(6)

While cyclohexane (from petroleum) and furfural will help out as raw materials for nylon; while toluene (which is now little more costly than benzene) will be increasingly used for detergents and other purposes, "the only permanent solution will be to produce benzene in some other way, and petroleum cracking is the only visible economic probability. . . The best informed opinion (however) seems to be that it will require a price level of 30c per gal. or more to make it interesting as a venture,"(6) but it appears quite probable that benzene prices will rise gradually from their present level of 19c per gal. "sooner or later—probably sooner" pass toluene in price (23c per gal.) and reach "a point where its synthesis by cracking petroleum is economic.

"The future (of industrial aromatics) depends on petroleum raw materials and, as the needs increase, this source will be expanded so that eventually it will be the principal base of these products."

Synthetic Detergents Attract Attention

AS *Business Week* points out,(7) "manufacturers are going in for further development and marketing of soapless soaps as soap fat prices rise." In particular, Colgate-Palmolive-Peet Co. is said to be ready to begin a national sales campaign on its new detergent toilet "soap", Vel, following highly successful market testing of the 25-cent bars in four midwestern areas. "A favorable factor is the name, which is the same as that of the company's well-established soap flakes."

As it happens, Vel "soap flakes" are also synthetic detergents, said to be made from the Oronite Chemical Co.'s "D-40," an alkyl aryl petroleum sulfonate. Base-product economies of similar detergents were graphically illustrated in a recent advertisement(8) of National Aniline which shows that Nacconol NR has sold for 13 cents per pound since 1940, while "88% tallow chip soap" has cost more than this since October, 1946 (29.5 cents per pounds in November, 1947).

Incidentally, the Colgate toilet "soap" is of considerable interest as another indication that the detergents industry is overcoming previous difficulties concerned with preparing detergents in bar form. In line with this, Chemical Industries recently stated(9):

"Keep an eye open for a new cake-form synthetic detergent. Produced experimentally in Atlas Powder Co.'s laboratories, its commercial possibilities are now being evaluated. It is based on G-1226 (a fatty acid poly-oxyethylene derivative) and an organic filler. Atlas's manufacturing and sales policy is not yet definite; it may license cake-forming process to customers."

It is interesting to watch the development of acceptance of a "new idea" by the petroleum industry or the chemical industry. Ten years ago, few would have forecast that the *economic* significance of the Synthine process would now be commonly accepted, and not many more would have been enthusiastic about the possibilities of synthetic detergents as direct competitors for soap. Times have changed, and these changes, coupled with scientific and technologic advances, have brought many facts into focus. No one can safely predict exactly what part of the soap market will be eventually taken over by the synthetic detergents, but it certainly seems likely it will be a large one.

(4) Latta, J. E. and Walker, S. W., "Commercial Application of Hydrocarbon Synthesis in the United States," *Chemical Engineering Progress* 44, No. 2, 173-76 (1948).

(5) Sullivan, F. W., Jr., "Fuel Synthesis By-Products As A Source of Chemicals," *Chemical Engineering Progress* 43, No. 12, Supp. pp. 13-17 (1947).

(6) Weiss, J. M., "Economic Trends in Coal Tar Hydrocarbons," *Chemical and Engineering News* 26, No. 4, 238-40 (1948).

(7) Anon., "Soapless Soap Scores," *Business Week*, No. 961, 53 (1948).

(8) Anon., "Cost Comparison—Nacconol NR *vs.* Soap," *Chemical Industries* 62, No. 1, 11 (1948).

(9) Anon., "Newsletter," *Chemical Industries* 62, No. 1 (1948).

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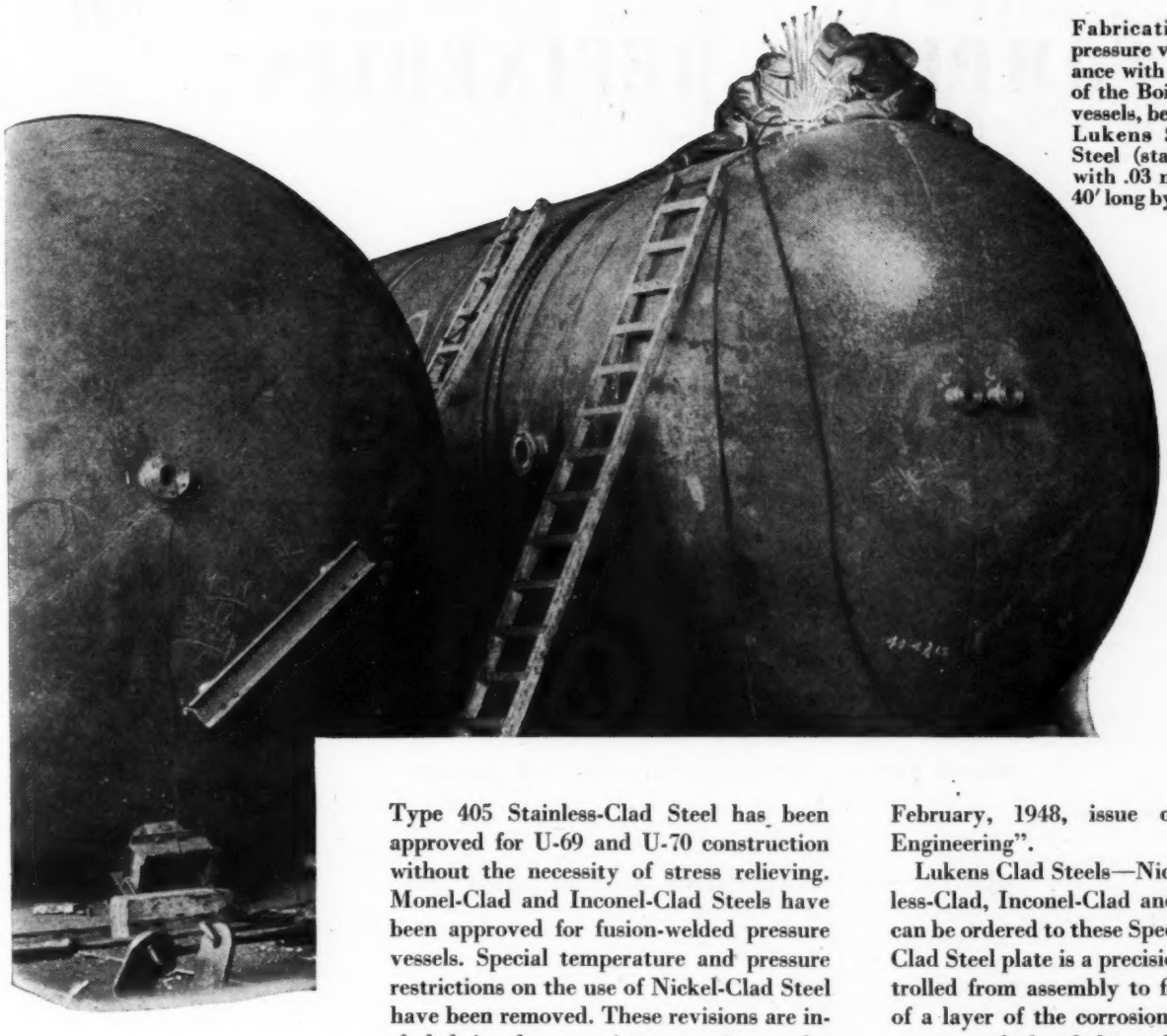

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Materials covered by this approval are described in ASME (also ASTM) Specifications SA-263 on chromium steel clad plates, SA-264 on chromium-nickel steel clad plates and SA-265 on nickel and nickel-base alloy steel clad plates. Complete details of the Case appear in the February, 1948, issue of "Mechanical Engineering".

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Two Decades of Research Put Industry On Top of Synthetic Fuels Problem

By WILLIAM F. BLAND
Engineering Editor
PETROLEUM PROCESSING

TODAY, as a result of two decades of foresighted research, the petroleum industry has the necessary development experience to produce synthetic liquid fuels on a commercial scale—if and when natural crude is unable to meet the demand.

That is the consensus of leading petroleum researchers and technologists in the country, expressed in a recent nation-wide survey of major oil companies. The survey was conducted by PETROLEUM PROCESSING to determine as accurately as possible just what our industry has been doing in the field of synthetic fuels.

Among other things, the survey discloses on the research side of the picture that:

(1) Nearly $30,000,000 of private capital has been expended by oil companies during the past 2-3 years on synthetic liquid fuels research.

(2) Their present research expenditures on synthetics are at the rate of about $10,000,000 a year—with prospects that the figure will go up, not down.

(3) Practically every major oil company is now active in the synthetic fuels field, a few only recently, the majority for a considerable length of time, and at least one for over 20 years.

Commercial Plants, Too

On the commercial side, this extensive background of research and development work is already making itself apparent:

(1) Two commercial processes for producing liquid fuels from natural gas are now available for licensing.

(2) Two commercial plants for converting natural gas into gasoline and other fuels are under way, one actually being constructed.

(3) A third commercial plant for gasifying coal and converting it to liquid fuels is being designed in this country for a South African firm.

The survey emphatically refutes the impression given by most newspaper accounts of current congressional investigations and committee hearings, which lead the average layman to the conclusion that everything we now know about converting coal, natural gas and shale into gasoline, Diesel oil and fuel oil is the result of work done by the Bureau of Mines.

Most oil companies are fairly tight-mouthed about just what they're doing in the way of research on synthetics, what processes they're interested in and how much they're spending. And even though their attitude backfires by creating an incorrect impression on the public, it is understandable—considering that the synthetics field may shortly become very competitive. They are not willing to disclose to the general public—and thereby to other oil companies—the exact nature, extent, costs and other details of their research work.

Research on the subject is not new to them, however, as the survey has brought out. Many authorities who discussed the situation with PETROLEUM PROCESSING pointed out that achievements of the oil companies to date in preparing for the commercial production of synthetic fuels are far more important than those of the government program being carried out by the Bureau of Mines*.

As one oil company executive stated, the Bureau has done some valuable work, but industry is putting a great deal of emphasis on synthetic fuels research and development and is "definitely carrying the ball" on research on synthetic fuels from natural gas.

S. O. D. Active Since 1929

Among private oil companies, Standard Oil Development Co., research subsidiary of Standard Oil Co. (New Jersey), is one of the most active in synthetics research. E. V. Murphree, president of the Development firm, told PETROLEUM PROCESSING that his company has already spent a total of $10,000,000 on recent synthetics research. This figure does not include large expenditures made on hydrogenation of oil and coal.

(In hearings of the House Armed Services Oil Subcommittee in Washington Feb. 25 it was stated by Murphree that his company has spent $26,000,000 for research and development work on coal hydrogenation.)

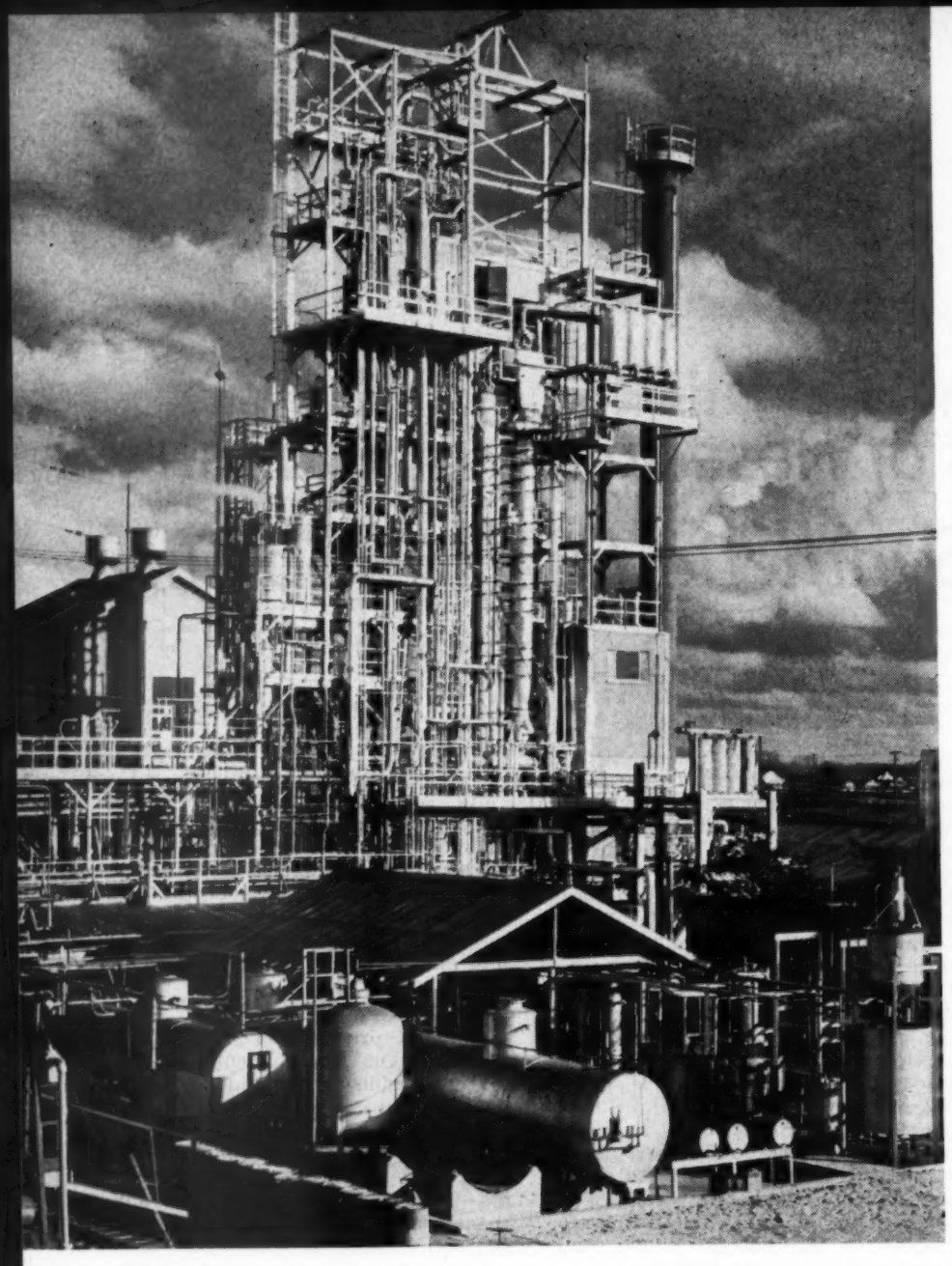
S.O.D.'s interest in synthetic fuels dates back to 1929, when it began investigating work on coal hydrogenation. Since then it has also done considerable work on shale, and has devoted a major portion of its research at various times to improving the basic German Fischer-Tropsch process, now commonly referred to as the gas synthesis process. At present, S.O.D. is doing a great deal of work on gasifying coal to produce a synthesis gas for conversion to liquid fuels.

In co-operation with Pittsburgh Consolidation Coal Co., the Development company is now building a pilot plant near Pittsburgh for research

The Sources

In gathering the factual data presented in this article, seven members of the editorial staffs of PETROLEUM PROCESSING and *National Petroleum News* contacted 29 executives connected with 21 major oil companies and affiliated organizations. The data was secured by means of personal interview, long distance telephone, teletypewriter, telegram and mail.

* For a review of developments in the Bureau's program during 1947 see pp. 207, 208 in this issue of PETROLEUM PROCESSING.



General view of part of the pilot plant operations of Standard Oil Development Co. at Baton Rouge, La. S. O. D. at present has three pilot plants of up to 10 b/d capacity operating at Baton Rouge, all on the conversion of natural gas to liquid fuels

on this subject. The basic plant for this joint research activity is expected to be in operation late this spring, and will cost, along with the research, $1-1.5-million. If it is decided to build a full demonstration plant, it will probably cost in the neighborhood of $2,000,000 additional, along with the research, according to Murphree.

Also Building Shale Plant

S.O.D.'s oil shale work will be carried out in a demonstration plant now being built at Baton Rouge, La., which will employ a double-vessel retorting system. Standard's double-vessel method, which Murphree feels is a promising development, is an outgrowth of work undertaken for the Board of Economic Warfare during the war, when use of oil shale in Australia was considered to provide some liquid fuel supply for that country.

This shale demonstration plant will have a charge capacity of 18 tons of shale daily, from which it is expected to retort 13 b/d of oil. Shale will be provided by the Bureau of Mines from its demonstration mining operations at Rifle, Colo.

From another source it has also been learned that S.O.D. is conducting tests at its Elizabeth, N. J., and Baton Rouge laboratories on methods of refining the shale oil now being produced by the Bureau at its Rifle retorting plant.

Work on the synthesis process is being carried out in the Development company's laboratories at both Elizabeth and Baton Rouge. Four to five pilot plants have been set up at these points for converting natural gas to liquid fuels, with three presently in operation. All of those operating are at Baton Rouge, and the largest has a capacity of 5 to 10 b/d.

Texaco Also Active

The Texas Co. is another leader among oil companies in research on synthetic fuels. Just last month Dr. W. E. Kuhn, manager of Texaco's Technical and Research Division, estimated that his company had spent approximately $1,000,000 last year on synthetics research, and would spend the same amount in 1948. The company, according to Kuhn, has "a very substantial number of technical manpower assigned to work of this nature." These figures on research expenditures, it was understood, do not include Texaco's financial support of research conducted by Hydrocarbon Research Inc.

At the same time that Kuhn revealed Texaco's synthetic fuel research expenditures, L. C. Kemp, Jr., Texaco's director of research, reported completion of new laboratory buildings and a 12 b/d Hydrocol gas synthesis pilot plant at Montebello, Calif. Research at the Montebello facilities, Kemp said, is devoted entirely to synthetic fuels.

The Texas Co. has in operation at the present time at least a dozen pilot units on various phases of the synthetic fuels problem.

Work being done in the Texaco laboratories is primarily concerned with the gasification of coal and heavy fuel oil, and improvements of the Hydrocol process. Although the company holds large shale acreage in Colorado, it at present is conducting no research in oil-from-shale. It has done extensive work in the past, however according to Kuhn, on shale oil processing, and will do additional work as various types of shale oil become available from retorting studies now being made by the Bureau of Mines and others.

Indiana Standard Favors Gas

Considerable research work has been done by Standard Oil Co. (Ind.) and its subsidiary, Stanolind Oil and Gas Co., in developing a commercial method for producing liquid fuels from natural gas. According to J. K. Roberts, research director for Indiana Standard, they have been carrying on experimental work on the basic Fischer-Tropsch gas synthesis process since 1938. They have not, however, Roberts says, done any experimental work on coal hydrogenation or oil from shale, since earlier paper studies indicated that both methods of obtaining liquid fuels are far behind the conversion of either gas or coal by means of the gas synthesis process.

Well over a million dollars a year is being spent by the two companies for research on synthetic fuels, Roberts told PETROLEUM PROCESSING.

At Tulsa, Okla., Stanolind has a re-

search organization of 234 persons operating a pilot plant for studying fuel synthesis — a plant which one source has described as the largest of its kind in the world. Stanolind officials say it represents an investment "of several millions of dollars."

Stanolind's first pilot plant on the gas synthesis process employed a 2-in. reactor and was started over four years ago. A second and larger pilot plant, with an 8-in. reactor, was started near the first one last October, and is making synthetic gasoline from natural gas at the rate of 4-5 b/d.

Several Firms Co-operating

Among the co-operative research projects, the one sponsored by Hydrocarbon Research, Inc., is probably the most extensive. That privately-owned organization has been working on the problem of synthetic liquid fuels since it was founded in 1943, and has developed the Hydrocol process, one of the most promising for commercial operations.

President of Hydrocarbon Research is P. C. Keith, who claims to be responsible for the first work ever done in this country on a commercial process for producing liquid fuels synthetically from gas. He has been one of the foremost proponents of a synthetic fuels industry, first becoming interested in the subject back in 1932 when he was vice president in charge of research, development and engineering work for M. W. Kellogg Co.

Keith left Kellogg in 1943, and convinced Jim Abercrombie of J. S. Abercrombie Co., Oliver Little of Magnolia Petroleum Co., and R. T. Wilson of LaGloria Corp. to put up the monies for a research project on making liquid fuels from natural gas. Hydrocarbon Research was established to carry out that research, and set up a pilot plant at Olean, N. Y., from which evolved the Hydrocol process.

The company's laboratories at Trenton, N. J., are reported to be 100% occupied on synthetic fuels. Keith, in a talk Jan. 29 before a Gulf Coast regional meeting of the Natural Gasoline Assn. of America, revealed that a coal gasification pilot plant of 10 tons daily capacity is now in operation at Trenton. It is producing, he stated, a 750-B.T.U. gas at thermal efficiencies of 75 to 80%. This, Keith says, is equal to producing 3 bbls. of oil per ton of coal. Cost of the gas is 21c per 1000 cu. ft. on a B.T.U. basis, he declared, with the plant using West Virginia coal costing $2 a ton at the mine mouth.

Kellogg Active Since Early 30's

M. W. Kellogg Co., one of the leading engineering firms serving the petroleum industry, has been active in synthetics research for some time. As far as is known it is the only petroleum engineering firm carrying on such activities.

The company first began investigating synthetic liquid fuels in the early 30's, and has continuously conducted research in that field since then. Its research has been based on the Fischer-Tropsch gas synthesis process, and the company states that its "total expenditures to date involve many millions of dollars."

For the past year and a half, Cities Service Oil Co. has been co-operating with Kellogg in a joint research program on synthetic fuels, according to A. P. Frame, vice president of Petroleum Advisers, research affiliate of Cities Service. At present the joint program includes operation of three synthesis pilot plants—at Lake Charles, La.; Tallant, Okla.; and Jersey City, N. J.

Last October Cities Service announced the creation of a new company, Cities Service Research and Development Corp., to centralize and expand research activities. The major project of the expanded program at that time was reported to be synthesizing liquid hydrocarbons from natural gas.

Other Oil Company Activities

Gulf Research and Development Co. has been engaging in studies on the subject for at least five years, and one company official reports it has already spent or budgeted "several millions" for synthetics research. So far its work has all been conducted in the company's laboratories at Harmerville, Pa., where a small pilot plant has been operating on the Fischer-Tropsch process.

A second and larger pilot plant for erection outside the laboratory is now on the boards, according to Paul D. Foote, executive vice president of Gulf Research. Although construction of the large-scale pilot plant has not been authorized as yet, it is expected to cost about $1,000,000 and will have a capacity of from 50 to 100 b/d.

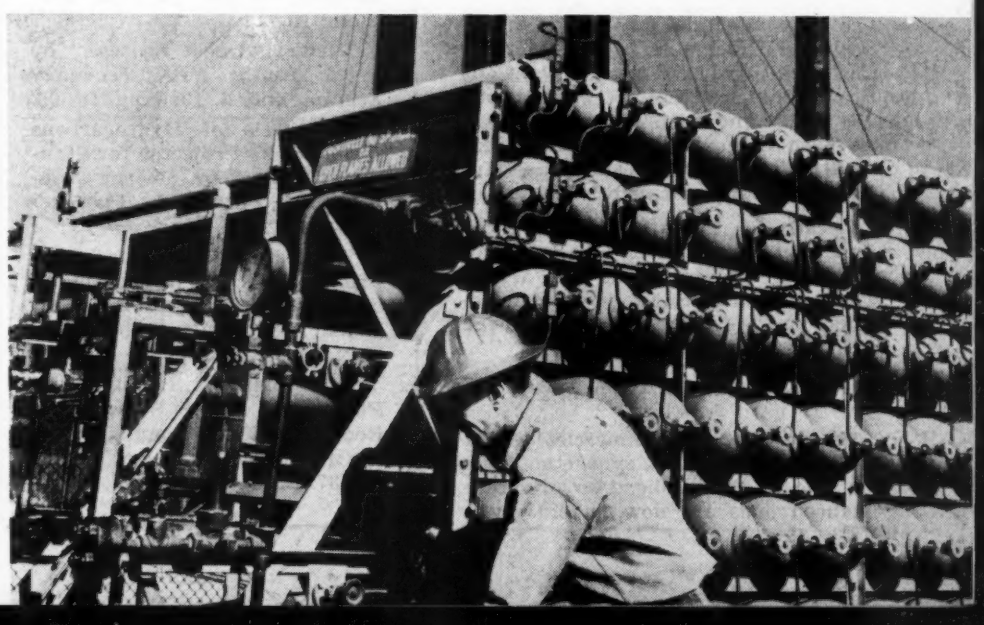
California Research Corp., subsidiary of Standard of California, first started research work in the synthetic fuels field over 20 years ago, H. G. Vesper, president, reports. This work at first was primarily concerned with shale investigations, and was later expanded to include coal hydrogenation, tar sand and gilsonite conversion, and other related processes. Several years ago California Standard announced acquisition of an interest in the gilsonite fields in Utah and Colorado, and has since been examining methods by which this material could be converted into a source of synthetic crude oil.

Sinclair Working on Shale

Sinclair Refining Co. has just recently become interested in the synthetics field, and about a month ago Senator O'Mahoney (D., Wyo.) reported that the company is preparing to conduct laboratory tests on how to best process shale oil after it has been recovered from the shale. Crude shale for these tests will be supplied by the Bureau of Mines from its retorting plant at Rifle, Colo. Work will also be done on shale retorting, another source reports. All of these research activities will eventually be carried on in the new $7,000,000 research and development plant now being built by Sinclair at Harvey, Ill.

Socony-Vacuum Oil Co., according to W. M. Holaday, director of the Socony-Vacuum Laboratories, is contributing to the research being conducted by Hydrocarbon Research on liquid fuels from natural gas, and

The Texas Co. last month announced completion of a new 12-b/d Hydrocol gas synthesis pilot plant at Montebello, Calif. This close-up view shows a manifolded bank of gas cylinders installed at the plant



spending $3-4-million. Socony in the past has also been interested in shale oil, and during the war operated a $500,000 pilot plant for producing oil from shale at its Paulsboro laboratories. No new work is being done now on shale, however, the company states.

Shell Development Co. is another participant in the work being done by Hydrocarbon Research, although Shell's interest is in the coal gasification phase. In its own laboratories, both in this country and abroad, Shell is also conducting experiments on the gas synthesis process.

Union Oil Co. of California is another firm which Senator O'Mahoney reported as co-operating with the Bureau of Mines shale oil project. Union, the Senator said, has undertaken the construction of a retort at Los Angeles to process up to 50 tons of oil shale daily, the shale to be supplied by the Bureau.

Sun Oil Co. and Phillips Petroleum Co. are also engaging in research on synthetic fuels, but no details as to the nature or extent of their programs have been revealed.

Commercial Processes Announced

Two processes for manufacturing synthetic fuels from natural gas have already been developed by private industry to the stage where commercial plants can now be designed.

One of these is the Hydrocol Process, licensed by The Texas Co., and the other is the Synthol Process, licensed by M. W. Kellogg Co.

The Hydrocol Process, as previously pointed out, was developed as a result of an intensive research undertaking begun in 1943 by Hydrocarbon Research. The process is owned 50-50 by The Texas Co. and Hydrocarbon Research. Its availability for licensing was announced last month by W. M. Stratford, president of Texaco Development Co., patent-holding affiliate of The Texas Co.

First commercial application of the Hydrocol Process is to be made by Carthage Hydrocol in a plant at Brownsville, Texas. Conversations are proceeding with several companies both here and abroad, according to Stratford, to build additional Hydrocol gas synthesis plants.

Details on the availability of the Synthol Process through Kellogg had not yet been released as this article was being written, but it was understood that such an announcement would be forthcoming shortly.

Two Commercial Plants

In the field of commercial plants to actually produce synthetic fuels for sale to the public, two privately financed ones are now under way—the one by Carthage Hydrocol, Inc., referred to above, and the other by Stanolind Oil and Gas Co. Both are employing gas synthesis processes and are using natural gas as their raw material.

A third commercial plant is also being designed in this country, but for erection in South Africa. Process engineering work for it is being handled by Hydrocarbon Research. It will employ coal, however, instead of natural gas, the coal being gasified and then converted to liquid products by means of the Hydrocol process.

The South African plant is to be built by Anglo-Transvaal Consolidated Investment Co., at an estimated cost of £14,000,000. It will be situated at Vereeniging, south of Johannesburg, and construction is expected to be started in about 18 months, with the plant possibly in operation within 3-3½ years. It is being designed to produce 7500 b/d (U. S. bbls.) of liquid products from 42,000 tons of coal.

Carthage Plant Already Begun

The Carthage Hydrocol plant at Brownsville is actually under construction. Engineering is all finished, pilings have been driven, and foundations are being poured, according to P. C. Keith, who is also president of Carthage Hydrocol. The plant will be completed, he believes, by May, 1949. It was expected to cost $19,000,000—but will probably run higher.

Processing 80,000,000 cu. ft. of natural gas daily, the plant will produce about 7400 b/d of liquid fuels, as well as quantities of chemicals.

Previous Articles

Earlier articles in PETROLEUM PROCESSING and its predecessor, the *Technical Section* of *National Petroleum News,* have described the two commercial synthetic plants now being built and other work of the oil industry in the field of synthetic fuels:

"New Hydrocol Process," by P. C. Keith; *NPN Technical Section,* July 3, 1946, pg. R-506.

"Synthesis of Hydrocarbons from Gas as Projected for Stanolind Plant," by George Roberts, Jr.; PETROLEUM PROCESSING, Dec., 1947, pg. 905.

"Processing Coal Into Liquid Products May Be Practicable in a Few Years," by William F. Bland; PETROLEUM PROCESSING, May, 1947, pg. 325.

"Oil Company Synthetic Fuels and Lubes Show Good Records in Navy Tests;" PETROLEUM PROCESSING, Jan., 1947, pg. 37.

Engineering is being handled by Hydrocarbon Research, with the construction work being done by Arthur G. McKee and Co., Cleveland.

To finance the project, eight companies joined together to form Carthage Hydrocol, Inc. The participants and their stock contributions: The Texas Co., $3,778,125; Forest Oil Corp., $1,259,375; Niagara Share Corp., $1,259,375; United Gas Corp., $1,007,500; La Gloria Corp., $1,007,500; Gulf States Oil Co., $377,812; Stone and Webster, Inc., $377,812; The Chicago Corp., $503,750. In addition, the Reconstruction Finance Corp. is putting up another $9,000,000.

Stanolind Plant in Kansas

The Stanolind plant, to be located near the Hugoton gas field in southwestern Kansas, is not yet under construction. Work is expected to get started, however, according to latest announcements, in March or April. Information released early in January by Kansas Gov. Frank Carlson indicated that the plant would not be completed until January, 1950, but at that time Gov. Carlson also said construction would be under way by the end of February.

Process design for the Hugoton plant is being handled by Hydrocarbon Research under the direction of Stanolind. Engineering will be handled by the contractors, who have not yet been announced. The plant will require about 100,000,000 cu. ft. of natural gas daily, plus 53,000,000 cu. ft. of oxygen, and will produce about 5400 b/d of gasoline, 700 b/d of distillate fuel and 300 b/d of fuel oil.

Stanolind, a wholly-owned subsidiary of Standard Oil Co. (Ind.) is financing the cost of its project entirely itself. The cost, although Stanolind has made no announcement regarding it, has been estimated as high as $80,000,000. That figure is considerably more than the one given for the Carthage plant, although both will have about the same capacity. Probable reasons: Stanolind is including an extensive gas gathering system (more than 400 miles), a natural gasoline plant to dry the gas before it reaches the synthesis plant, and facilities for separating the chemical by-products. In addition, it is reported that the Hugoton gas is lower in quality than that available in the Brownsville area.

♦ ♦ ♦

The foregoing summary of what private oil companies are doing in synthetic liquid fuels is not intended as a complete history of their activities in this important field. Rather, it is intended to point up the fact that they have for a good many years been actively pursuing the problem, even though their results have not been publicized as widely as those of the Bureau of Mines.

Bureau of Mines Reports Its Progress In Synthetic Liquid Fuels Research

As Condensed from the Secretary of Interior's 1947 Report to Congress

PROGRESS made during the past year by the Bureau of Mines in its $30-million research program on synthetic liquid fuels includes:

1) Opening of two oil-shale mines at Rifle, Colo., one for selective mining of small quantities of shale and the other of sufficient capacity to determine daily production rates and mining costs on a commercial scale.

2) Completion of the crushing and retorting sections of the shale oil demonstration plant at Rifle.

3) Start of construction of a 200 b/d coal hydrogenation demonstration plant at Louisiana, Mo.

4) Design of a 50 to 80 b/d Fischer-Tropsch demonstration plant, construction of which is expected to start this summer at Louisiana, Mo.

These and other details on the Bureau's program and progress made to date are contained in the annual report of the Secretary of the Interior, released just last month, on the 1947 operations of the Bureau under the Synthetic Liquid Fuels Act. This Act, passed by Congress in April, 1944, authorized the "construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shales, agricultural and forestry products, and other substances." It specified that the program was to run for not more than five years and that not more than $30-million was to be appropriated for it. The amounts appropriated or budgeted to date are given in Table 1.

Highlights of some portions of the report with respect to demonstration plants are given below:

Oil Shale Mining

One of the two oil shale mines now being operated is for selective operations. It is used to mine shale of any desired richness from 5 to 80 gals. per ton as needed in the retorting work.

The other mine is of much greater capacity. It is essentially an underground quarry from which can be produced 1500 tons of shale daily, the Bureau being of the opinion that this size operation will permit accurate determination of production per man day and mining costs. This mine has been in operation only since October and a production of 25 tons per man day has already been achieved. The Bureau anticipates that this production will reach 40 to 50 tons per man day during 1948.

In general the Bureau is adapting large-scale quarrying methods to the oil shale mining operations. Because of the nature of the shale, large underground rooms 60 by 100 ft. can be opened without danger, thus permitting the use of large shovels and motorized equipment to secure the greatest output per man hour.

Mining Costs

Using the most efficient practices developed to date at the oil shale mine, the Bureau estimates that the cost of mining oil shale on a commercial scale would run about $1 per barrel of oil produced. This figure is based on a mine that would supply 15,000 tons of shale a day, working two shifts. Since the shale in the Rifle area averages 30 gals. per ton. the output of one such mine would supply a refinery of approximately 10,000 b/d crude capacity—assuming complete recovery in the retorting operation.

Surface facilities for such a mine, including roads, yard excavation, power and water supply development, and buildings, would cost $1,100,000 at 1947 prices. The equipment, including drilling carriages, electric shovels, haulage trucks, service trucks and vehicles, ventilating and and air compression equipment, and utilities, would cost $1,800,000. These surface facilities, the Bureau estimates, would supply a mine that would produce 5,000,000 tons of oil shale a year for 20 years from one square mile.

Such a mine would require an overall force of 344 men, whose pay would cost $2 an hour at 1947 prices. The daily labor cost would therefore be $5500; supplies would cost $3500 daily; depreciation would cost $1500 per day. Total daily expenses would then be $10,500, or $0.70 per ton of shale. The goal of the Bureau's Oil Shale Mining Division is to reduce this cost to $0.50 per ton.

It should be pointed out here that the Bureau's report does not indicate whether the $1 per bbl. figure includes any profit on investment, nor whether it includes the cost of hauling the shale to the crushing and retorting area.

Crushing and Retorting Shale

A plant for crushing and screening the shale in preparation for retorting was completed last year at Rifle as part of the demonstration plant, and commenced operation in April. It will produce up to 80 tons per hour of screened shale, depending upon particle size desired.

Most of the shale prepared for retorting so far approximates 30 gals. per ton richness, and is crushed to pass through a 3.5-in. screen. Fines produced in this operation (through 0.5-in. screen) average about 25%. Although the report does not give any cost figures for equipment, it does point out that direct operating costs for preparing 3.5-in. shale average $0.19 per ton, which is equivalent to $0.27 per bbl. of oil. However, two men per shift are required for this plant, and the Bureau believes that a much larger plant could be operated with the same manpower.

Two N-T-U retorts have been built for recovery of the shale oil. The first commenced operation on May 8, with the other unit starting two weeks later. Since that time both retorts have operated continuously except for such inoperative periods

TABLE 1—Expenditures for Work on Synthetic Liquid Fuels*

Project	Actual 1945	Actual 1946	Actual 1947	Estimate 1948	Estimate 1949	Accumulated Total
Hydrogenation and Gas Synthesis, Research and Development	$1,571,969	$2,469,765	$1,856,140	$1,500,000	$1,500,000	$8,897,874
Hydrogenation Demonstration Plant	.....	1,606,595	5,099,178	3,000,000	1,622,422	11,328,195
Synthesis:						
Research on Gas Production	36,810	140,000	250,000	275,000	346,285	1,048,095
Demonstration Plant	.....	.....	1,042,000	500,000	500,000	2,042,000
Oil Shale:						
Research and Development	585,000	255,000	393,514	375,000	475,000	2,083,514
Mining	32,355	325,000	335,000	350,000	500,000	1,542,355
Demonstration Plant	370,467	780,000	1,000,000	1,000,000	996,800	4,147,267
Health Program	.....	.....	.....	.....	3,200	3,200
TOTAL Obligations	$2,596,601	$5,576,360	$9,975,832	$7,000,000	$5,943,707	$31,092,500
TOTAL Estimate or Appropriation	$5,000,000	$7,000,000	$5,250,000	$3,000,000	$9,750,000	$30,000,000

* As contained in the Federal Budgets for the fiscal years of 1947, 1948 and 1949.

Report Available

Copies of the "Annual Report of the Secretary of the Interior on the Synthetic Liquid Fuels Act," covering the period Jan. 1, 1947, to Dec. 31, 1947, can be obtained without cost by writing to Dr. W. C. Schroeder, Chief, Office of Synthetic Liquid Fuels, U. S. Bureau of Mines, Room 4428, New Interior Bldg., Washington 25, D. C.

as required for repairs and design changes, producing oil at the rate of about 50 b/d.

Very little cost data has been secured on retorting operations. The lowest monthly average unit cost obtained so far was $0.096 per gal., or $4.03 per bbl. (direct costs only). However, the Bureau believes that if both retorts had been in continuous operation throughout the month the cost would have been below $0.050 per gal. of crude shale oil, $2.10 per bbl.

Concurrently with the operation of the present retorting plant, three additional types of retorting units are being built and will be tested. In addition, negotiations for cooperative work on two other retorts are pending. First, an effort is being made to borrow the continuous retort owned by Union Oil Co., which is an internally-fired downdraft retort, small enough for preliminary pilot plant studies. The second is a relatively large pilot plant operated by Standard Oil Development Co. at Baton Rouge, La. This latter plant utilizes the fluidized catalyst technique and consists of two fluidized beds, one for retorting the shale and the other for burning fixed carbon in the retorted shale.

From all this work, the Bureau anticipates that it will be able to make recommendations this year or next concerning types of retorts suitable for commercial oil-shale operations in the U. S.

Shale Oil Refining

Pending completion of the refinery portion of the demonstration plant, the crude shale oil being produced is used in engine tests and refining studies, and the remainder burned in combustion tests in the boiler operating at the retorting plant. By relatively simple refining, the crude shale oil will yield a suitable No. 5 and No. 6 residual fuel oil. To make No. 3 distillate fuel will require reduction of the pour point and stabilization of color. To make light Diesel fuel and gasoline on a satisfactory commercial basis will require further development of refining methods. A light hydrogenation at 200 psi. pressure and 700° F. has given satisfactory results and at the same time has reduced the sulfur and nitrogen content of the oil.

To make the best progress on the refining work, the Bureau is undertaking a cooperative test program with a number of oil companies. Samples of crude shale oil produced at Rifle will be subjected to refining tests at company laboratories, and results reported to the Bureau.

Coal Hydrogenation Plant

A demonstration plant to produce about 200 b/d of gasoline by the hydrogenation of coal will be completed at Louisiana, Mo., in 1948. The plant will use from 100 to 200 tons of coal or lignite a day, western coals being used in initial operations because some of them are exceptionally amenable to the hydrogenation process. Other coals, including eastern, midwestern and southern, will be tested after plant operation has been smoothed out. Operating presures will vary from 4000 to 10,000 psi.

During the design work on this plant, extensive studies have been made of hydrogenation operations to improve the thermal efficiency and thereby lower the cost of gasoline and oil. This work shows that efficiencies, as measured from heat in the coal to heat in the oil produced, might be increased from about 30% (as found in some German plants) to more than 50%. A number of the potential improvements developed in this study are being tested experimentally and will be incorporated in the demonstration plant as soon as it is apparent they are practicable.

Under present conditions, and assuming the demonstration plant will show a reasonable degree of success in improving thermal efficiency, it is estimated that a high-grade motor gasoline or aviation gasoline can be produced commercially for about 14c a gal. This cost is based on amortization of the plant in 9 years but it does not allow for profit. On the other hand, no credit has been taken for by-products which might reduce the cost of the product for some plants by 3 to 5c a gal.

Fischer-Tropsch Synthesis

During 1946 and 1947 sufficient progress has been made in the Bureau's Coal to Oil Laboratories and Pilot Plants at Bruceton, Pa., and in the Synthesis Gas Laboratories and Pilot Plants at Morgantown, W. Va., to allow the design of a Fischer-Tropsch plant to produce motor gasoline and Diesel fuel from coal. This plant also will be erected at Louisiana, Mo., and will make about 50 to 80 b/d of oil. Construction will start this summer.

The plant will incorporate a new design of coal-gasification unit which has not been used in this country or abroad on any appreciable size. It also will have a newly-developed Fischer-Tropsch converter unit which is capable of enlargement to 500 b/d or more, as compared with the German converters that produced 18 b/d.

This Fischer-Tropsch process will produce a good grade of motor gasoline and excellent Diesel fuel with a cetane value between 80 and 100. It is not well adapted to the production of aviation gasoline or heating oil. Costs of production by this process are probably about the same as for the coal hydrogenation process.

Extension of Bureau's Program Almost Certain

An additional $30-million and three more years of life for the Bureau of Mines' synthetic liquid fuels research program was almost a certainty last month.

Late Feb. 5, the Senate passed the O'Mahoney bill (S. 134) extending the Bureau's synthetics program from June 30, 1949, to June 30, 1952, and increasing the present authorized cost limit from $30-million to $60-million.

Four days later, Feb. 9, the House of Representatives by unanimous voice vote passed a companion bill (H. R. 2161), previously introduced by Rep. Case (R., S. D.). Before it approved the Case bill, however, the House adopted an amendment earmarking $1-million of the additional $30-million for reasearch into methods of improving secondary recovery from stripper wells.

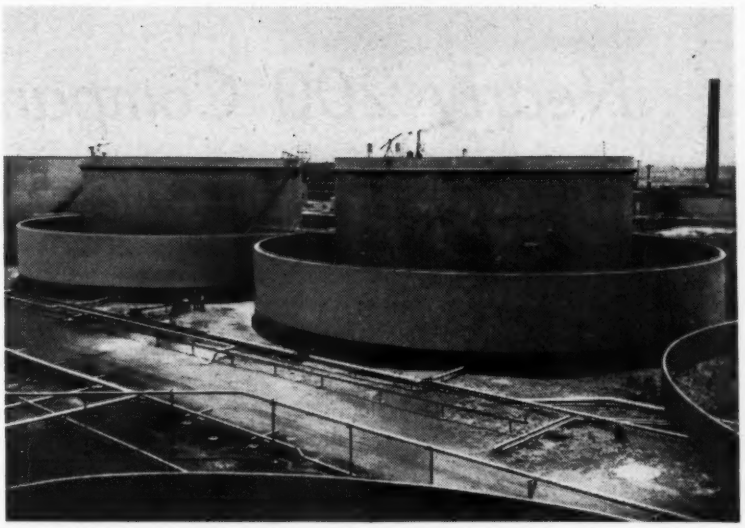
It was expected that the Senate would approve the House secondary recovery rider, particularly since the Bureau was reported to have no objection to it, and there was no doubt but what President Truman would sign the final bill.

The amendment giving a shot in the arm to secondary recovery research was offered by Rep. Gavin (R., Pa.), who told House that proper use of such methods might add another 4- to 5-billion barrels to amount of natural crude that can be economically produced in this country.

The Senate bill had been introduced more than a year previously (Jan. 10, 1947) but had lain dormant in the Senate Public Lands Subcommittee until persistent prodding by the administration aided by current interest in petroleum shortages and synthetics, shook the dust off it. It was taken off the shelf Jan. 29, quickly approved, and reported out of committee Feb. 2.

THIS MONTH'S COVER

Firewalls of Steel Gain Tank Capacity In Limited Space



This month's cover shows three 55,000-bbl. tanks at Sun's Newark terminal with new 22-ft. high steel firewalls installed

WHERE space limitations are of paramount consideration, steel firewalls provide economical safety barriers for oil storage tanks because they permit construction of larger tanks in a given area.

This has been the experience of Sun Oil Co. engineers, who report successful use of 22-ft. high, circular steel walls around three 55,000-bbl. capacity tanks at the company's Newark, N. J., terminal. Steel firewalls, these engineers found, also permit speedier construction than concrete walls of comparable height and diameter, in addition to their space-conserving qualities. The design and installation of firewalls have been approved by the local fire authorities.

Their construction is less expensive than concrete when heights over eight feet are required, but of course is greater than the cost of earthen barriers. Only disadvantage found to date is that steel requires periodic painting.

Principal problems encountered at the Newark installation were adequate provisions against corrosion, seepage through the base, and sufficient anchorage. Soil conditions, arising in this case from the terminal's close proximity to the Passaic River, made it necessary to set pile supports under the foundation. These problems were worked out by engineers of Sun Oil Co. and the Chicago Bridge & Iron Co., builders of the firewalls. Actual design of the walls followed API tank specifications with wind girders inside.

At the outset, 32 wood piles were spaced equally around a 140-ft. diameter circle, concentric with the 90-ft. diameter tank. On these piles was poured a reinforced concrete ring, two ft. square in cross section. (See Fig. 1.) The ring was reinforced horizontally by six one-in. square steel bars in two rows of three each —one row at the bottom and the other near the top. These bars were tied together by ½-in. diameter steel rods in a U-shape, the ends of which extended about 12 in. above the top of the concrete.

In the center of the two ft. top surface of the concrete ring was a two-in. depression, 8½ in. wide. Next step was to place a six-in. wide continuous base plate in this depression. On the center line was welded the bottom ring of the firewall. Then the projecting ends of the U-shaped rods were bent in and welded to each side of the bottom sheet.

To protect the bottom ring from corrosion, an additional foot of concrete was poured on top of the original base ring, covering the base plate and the extended rods. This was locked in place by the depression on the top of the original ring and by the bent-over rods.

As further protection against seepage and corrosion, the top of the last pour of concrete was sloped away to carry water from the vulnerable point where steel meets concrete. A one-inch groove was left on each side of the sheet, and was caulked with a fire-resistant mastic material.

As an added measure against seepage, all pipes leading through the firewall were carried through a sleeve one size larger than the pipe itself, and the annular space was packed with asbestos rope and sealed with mastic.

The firewall is equipped with ground-level manholes at diametrically opposite locations to provide access. Circular stairways outside the walls lead to catwalks which interconnect spiral stairways on the tanks themselves. In addition, escape ladders lead up and over the walls at points opposite the stairways.

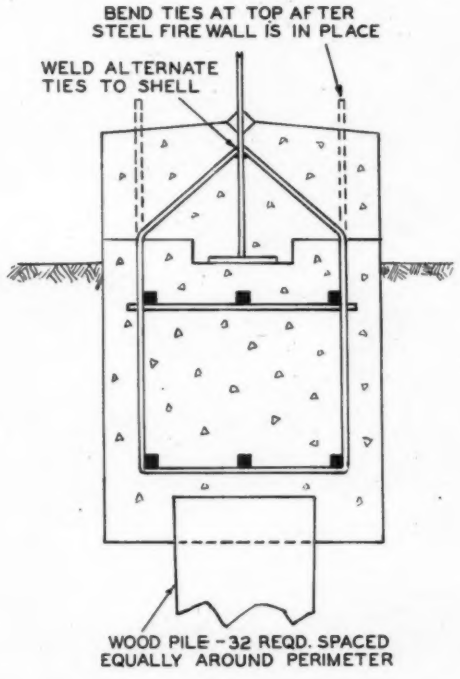

BEND TIES AT TOP AFTER STEEL FIRE WALL IS IN PLACE
WELD ALTERNATE TIES TO SHELL
WOOD PILE - 32 REQD. SPACED EQUALLY AROUND PERIMETER

Fig. 1—Typical section through steel fire wall showing construction of foundation. Upper section of concrete is poured after the ties have been bent over and welded to the lowest course in the shell. V-shaped groove at top, where wall leaves concrete, is filled with a fire - resistant mastic to serve as a caulking

Nearly 200 Companies Will Display Process Equipment at Tulsa Show

TULSA—Nearly 200 manufacturers of equipment and materials for the petroleum processing industry will display their products at the Silver Anniversary International Petroleum Exposition here, May 15-22, 1948. This represents almost 40% of the total of 500 companies on the exhibitors list.

The type of equipment to be shown will run the gamut of the refining industry's needs. It will include motors, turbines, pumps, compressors, valves and fittings, instruments and meters, tubing, expansion joints, vessels, exchangers, maintenance tools and supplies, insulation, fire protection devices, and the like.

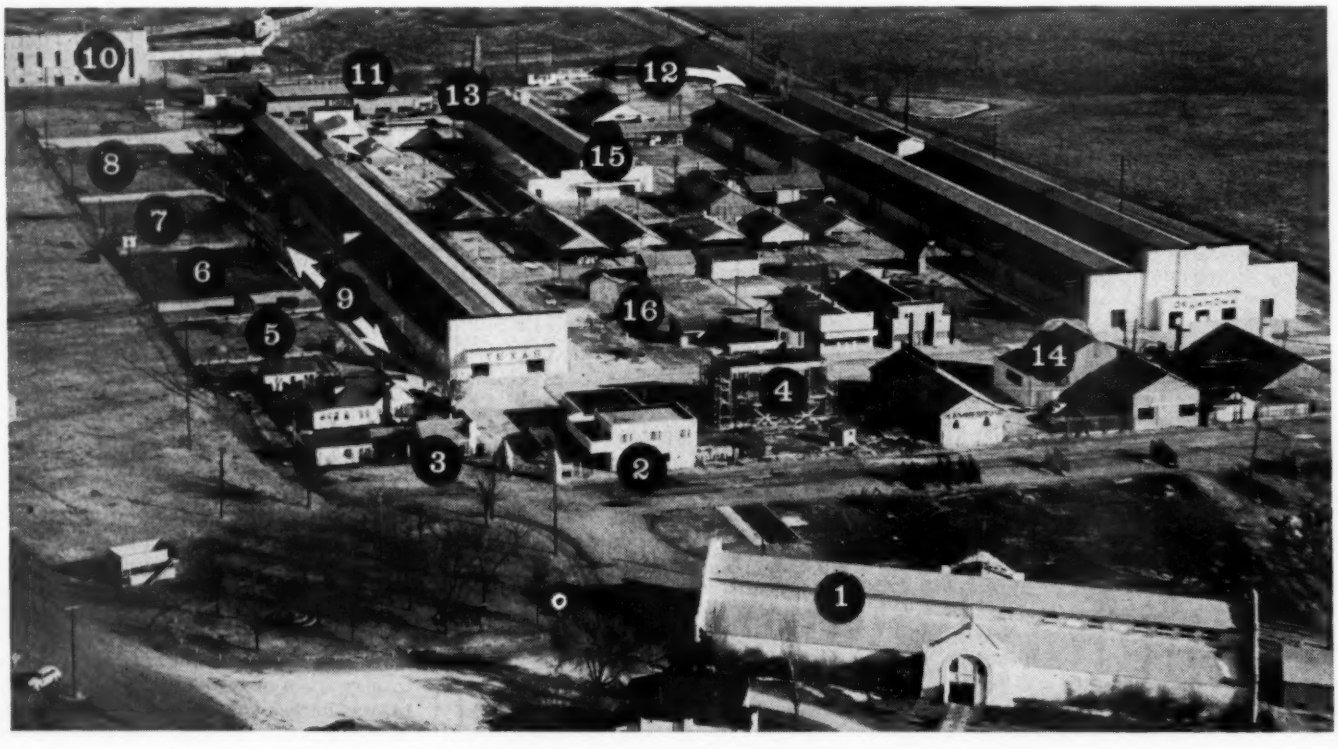
The thousands of visitors expected at this, the first exposition since 1940, will find refinery equipment displays throughout the 15 acres of the "world's largest industrial exposition." The displays will be located in all five major exhibition halls as well as among the many outdoor areas.

The extent of the huge exposition grounds and the layout can be seen in the aerial view above showing the many current construction projects now underway for this year's show. Major buildings or sites for buildings are indicated by the numbers on the photograph coresponding to the numbers below:

(1) Hall of Science; exhibits from all parts of the world that help tell the "Story of Petroleum" will be housed here. (2) General offices, and new international headquarters for the Nomads Society. (3) New four-room hospital. (4) National Supply Co. building, a new two-story structure now being built. (5) Site of Bethlehem Supply Co. building. (6) Site of General Motors Corp. building. (7) Chrysler Corp. building site. (8) Dresser Industries to erect new building here. (9) Silver Lane, new "white way" already flanked by 43 new display booths. (10) Coliseum, where many safety and other educational features of the exposition are to be held. (11) Enlarged cafeteria and restaurant. (12) An additional 25 display booths recently completed here. (13 New Hughes Tool Co. building. (14) Jones & Laughlin building, recently enlarged. (15) Scientific & Technical building, which will house hundreds of special exhibits. The new press and radio offices will be located here. (16) Six, smaller, exhibitor-owned structures will soon be built here.

With every square foot of available space in the 15 acres now under contract, and with a waiting list of over 200 more firms, the officials plan to accommodate several more exhibitors in the open area fronting the Hall of Science.

Arrangements were completed early in February for the best possible transportation to the show by more than 200 top rail, bus, and airline company executives from all sections of the country who gathered here for a series of planning meetings. The officials were taken for a pre-view tour of the exposition grounds by William B. Way, general manager of the International Petroleum Exposition since 1929.



Airplane view of International Petroleum Exposition grounds in Tulsa

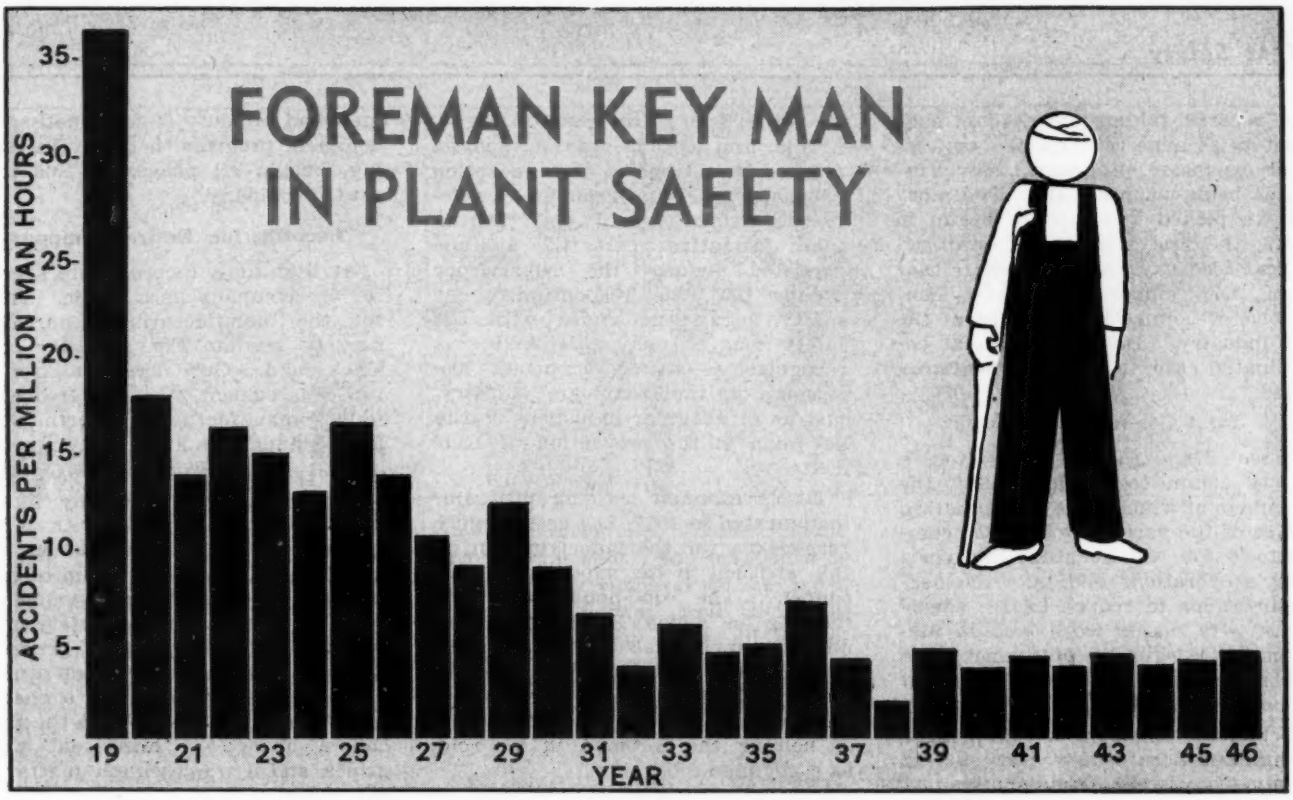


Fig. 1—Esso Standard Oil Co.'s accident experience, 1919 to 1946, based on records of the Bayonne Refinery

28 Year's Experience in Organized Accident Prevention Work at New Jersey Standard Refineries Has Emphasized Role Supervisors Play in Holding Down Plant Injuries: Foreman Training Program Includes Sessions on Safety

By WILLIAM C. UHL, Equipment Editor, PETROLEUM PROCESSING

"WHEN I came out of my house this morning, I turned right and saw the rising sun. Which direction does my house face?"

Approximately 73 Bayway refinery foremen attending one of Esso Standard Oil Co.'s* recent safety meetings paused to think that one out. Many probably also wondered what in the world it had to do with safety. But meeting leader J. E. Jeffries, the company's assistant chief safety engineer, knew what he was doing.

Answers called back to him from the audience were, "North," "South," "East," "West," and "Which door did you come out?" The last one was the correct answer.

"You see," explained Jeffries, "I didn't give you complete information. You had to know which door I came out in order to answer correctly." Then, without explaining further, he shot another one at them:

"Suppose I had a horizontal line, say two feet long. Then I drew a vertical line one-half its length, or one foot long, going up from one end of the horizontal line, and another, also one foot long, going down from the other end. (*Editor's note: try this on the margin of this page*). Then I drew a line connecting the ends of these two vertical lines. What would I have?"

"Two triangles," was the answer heard from all corners of the meeting room.

"Wrong again," said Jeffries, and went on to demonstrate: "I wouldn't have anything. I didn't say whether the connecting line was straight, curved, zig-zag, or what-have-you. You see, again I didn't give you complete information."

Instructions must be complete every time. It is easy to see now how a misunderstanding can occur by the omission of just one word or phrase, Jeffries said. Obviously, this applies to any form of instruction in a refinery, whether it be telling an employe to shut a valve, check a temperature reading, or how to pull on a wrench safely.

This particular safety meeting was one of a series of six one-hour sessions, each for a different group of foremen and supervisors, being conducted on company time until all 400 of the foremen at Bayway had been included.

The meetings were illustrative of the many facets in Esso Standard's safety program, which has an intensely interesting history of some 28 years of lower and lower accident rates. See Fig. 1.

The story of this 28-year fight for safety, was even more fascinating as R. W. Black, Chief Safety Engineer for Esso, and Mr. Jeffries unfolded it for me later. I had been hopeful of showing how each dip in the accident curve could be tied to a specific new activity or a specific new mechanical safeguard adopted by the company down through the years. But it's not as simple as that, Mr. Black said.

Safety Is Teamwork

Safety, he emphasized, is quite complex. For one thing, it is teamwork between management and labor, between the foreman and his crew, between operators and maintenance men, between one man and his buddy working alongside of him. It's the company providing the safest equipment and tools available and the employes providing the safest attitude. Esso's quarter century of accident and fire prevention wasn't simply the result of a series of "one-shot" improvements. Rather it was an accumulative result of the effects of a great many factors, some helpful and some detrimental that had to be overcome.

This was brought out with even greater emphasis as we sat in Mr. Black's office and read the story from

* Standard Oil Co. of New Jersey on Feb. 2 changed its name to Esso Standard Oil Co., to avoid confusion with the name of the parent Standard Oil Co. (New Jersey).

the records, taking into account such factors as huge construction projects and expansion programs, new processes being adopted, etc. The story as we picked it up really began in 1919, the first year that overall accident records were kept. Before that time, the company was safety-conscious, of course, as was most of the oil industry. However, no real coordinated effort to stop accidents existed.

First Committee in 1911

Esso Standard had appointed a safety committee back in 1911, the members of which were the operating heads of the various works. The committee's job was to study the company's operations and take the necessary steps to reduce unsafe conditions. Its major work was in mechanical safeguards and among its accomplishments was the protection of power machinery.

While the members of this pioneer committee were vitally interested in safety, they were primarily trained in and responsible for the manufacture of petroleum products. They had little time or "know-how" to carry on a sustained program.

In 1919, the company appointed E. A. Timm the first full-time safety supervisor and assigned him to the Bayonne works. The frequency rate that first year at Bayonne was almost 36.0, that is 36 lost-time accidents per million man-hours worked.

By 1920 safety supervisors had been assigned to full-time duties at each of the company's larger works. Immediately gratifying results were obtained, as shown in Fig. 1. For example, the frequency rate at Bayonne dropped to 18.2, virtually a 50% improvement. This was substantial proof that a full-time sustained program in each plant was a paying investment, both in relief of human suffering and in cost of accidents.

The years 1920-21 found the safety supervisors taking over the duties previously handled by the safety committee and the operating heads fading out of the active picture. A fairly steady downward course led to an accident rate of about 9.0 in 1928. There were two years, 1922 and 1925, when the rates rose a few notches. These two years were marked by the installation and operation of new processing equipment with all the expected problems of construction and learning how to operate the units. In 1922, pressure stills (250 psi.) went on stream; in 1925 there was some conversion to use of 350 psi. stills.

In 1928, 750 psi. thermal cracking coils began replacing some of the older units. This period again presented problems similar to those encountered in 1922 and 1925. As a result the frequency rate rose to about 12.5 as can be seen in the chart in Fig. 1.

This first decade was in general marked by a trend in the conception of what a safety program and a safety department could do. During these formative years, the attitude persisted among the supervisory groups that the responsibility for safety began and ended with the safety man. Today this feeling is recognized as entirely erroneous. The foreman in the petroleum industry, just as in all other industries, is the key man in the prevention of accidents.

Esso's foreman training program, inaugurated in 1927, has been largely responsible for the indoctrination of this attitude in the supervisory personnel. The one-hour foremen's meeting in which Safety Engineer Jeffries emphasized the importance of complete instructions is an example of the kind of activity the Safety Department is following as a means of helping the foreman in his role as a key man.

New Approach To Statistics

The use of a new approach to emphasize some oft-repeated safety statistics was vividly demonstrated at one point in Mr. Jeffries' talk. He had already pointed out that misinformation was one cause of human failures and injuries. He wanted to show that accidents are also caused by taking chances.

"We take chances when we are gambling because we want to win something—money or some material reward," he said. "Now, statistics tell us that, for every 330 accidents or potential accidents, 300 times no injury happens, 29 times some minor injury occurs, and once a very serious injury or even a fatality pops up."

Then he placed a glass jar with some large white pills in it on the table. "Gentlemen," he said, "here is a bottle with 330 pills. Three hundred of these pills are harmless sugar candy, 29 are a mild laxative, and one of them is poison, not deadly, but it would give anybody a *very* rough stomach ache. Now, I'll give any man a dollar—here it is, a nice crisp greenback! Yes, I'll give any man this dollar bill who will come up here and take a pill from this bottle and eat it." He had no takers, naturally, in this illustration of the odds against you when you take chances with accidents.

To return to the history of the safety program. By 1930, the management was satisfied that results from the safety programs in the various works was good, but felt that further improvement was still possible. Accordingly, a chief safety engineer for the entire company was appointed, R. W. Black. He and his staff had the duty of coordinating the complete program, not only in refining, but in all phases of this integrated company.

Records for Entire Company

At that time, records were started for the company as a whole. Those for the manufacturing department may be seen in Fig. 1 in the solid black bars. Once again, a drop in rate was evident. Accident frequency for the manufacturing department of Esso Standard in 1930 was about 12; in 1931 it had dropped to 6.5.

About 1930, the company inaugurated a policy of five-minute, informal safety meetings. Just at the beginning of a shift, a group of men engaged in a single craft would be gathered together by a safety man for an old-fashioned "bull session". By maintaining an informal atmosphere, the safety man had a chance to let "his hair down" and the men had a chance to bring out their gripes, and it was a simple matter to put across a safety thought.

As time went on, new angles were tried out and adopted. Instead of the safety man leading the discussion, he would turn the meeting over to the foreman or to one of the regular workmen. Usually, a complete, brief talk or an outline for one is furnished to the discussion leader by the Safety Department. These meetings are still held periodically.

Promotion of a safe-minded working attitude among all employes played a major role in the activities of Esso Standard's safety department during the second decade. In the late 1930's, several projects were undertaken, one of which "was a beautiful-flop," Mr. Jeffries told me. "It was one of those ideas we thought was sure-fire, but it never made the grade, and we don't know exactly why."

Prize Essay Contest Fails

The stunt was a prize contest, held in 1939. Money awards were established for the best essays on safety written by employes at both Bayonne and Bayway refineries. The contest was well-publicized in the *Esso Refiner,* one of Esso's employe publications, and in posters around the plants. But when the time came around for judging, there weren't even enough entries to cover the prizes.

A year previously, in November, 1938, management made a simple gesture which Esso's safety men are confident gave their cause a terrific boost. It was not a contest or stunt. There was no planning involved. Yet the very simplicity of it gave it tremendous power.

The employes of the Bayonne refinery had posted a record of 2,240,-

HEY, HOLD IT! THAT'S NO WAY TO USE A HAMMER—YOU'RE CHOKING IT. LET ME SHOW YOU.
FIRST, WHERE'S THE "BALANCE" OF THE HAMMER?
GEE, I DIDN'T KNOW THERE WAS SUPPOSED TO BE MORE OF IT
LOOK, TAKE HOLD OF THE HAMMER LIKE THIS. START THE NAIL BY TAPPING LIGHTLY UNTIL IT TAKES HOLD THEN——
USING AN ELBOW AND WRIST MOTION——
OUCH!
BAM!
SEE WHAT I MEAN! THAT'S THE WAY YOU'VE BEEN DOING IT. NOW, LET'S SEE YOU DO IT RIGHT!

Fig. 2—This cartoon, "Oscar Octane and Pentane Pete," was introduced to Esso's refinery employes on the pages of the "Esso Refiner" back in 1941. It appears in every issue of the bi-monthly, talking safety, conservation suggestion systems, etc.

000 accident-free man hours in the period July 21 to Dec. 2, 1938, for a total of 134 successive working days. On the day before Thanksgiving, when the record had reached 125 safe working days, each male employe received a cigar and each female employe a box of candy, containing a note reading:

THANKSGIVING

We have many things for which we should be thankful.

But we should be especially thankful that safety at the Bayonne Works during the past 125 *days has saved employes from injury*

In this spirit of Thanksgiving, the management gives each employe a souvenir of the day.

"The poor fellow who broke that record on the 135th day will be a long time living it down," laughed Mr. Jeffries, "especially since he was a foreman and his accident was falling off a bicycle while on an errand in the yard."

Cartoon Strip

Another activity which is going a long way to reducing accidents is the cartoon strip shown in Fig. 2. Inaugurated in the employe publication, *The Esso Refiner,* in July, 1941, it depicts the adventures of two mythical refinery employes, Oscar Octane and Pentane Pete. These two characters are supposed to represent the average employe, neither dumb nor too smart to be unbelievable. And as indicated in the sample strip shown, the cartoonist isn't held back from poking fun at safety men.

The cartoon strip is drawn by an outside artist who is not an employe of Esso. At first, he worked from ideas furnished him by the Safety Department. However, he has been at it so long now and has had a chance to study the human foibles of the average oil worker *and* his boss, so that he now works on his own with only occasional suggestions from the safety group.

A contest in which the Safety Department indicated the greatest pride was the "100-Day Safety Contest" which took place during the winter of 1941-42.

Jack-Pot Scheme Successful

It was a contest for money based on a jack-pot idea. But it didn't pit individual against individual, and it didn't pit high-hazard groups against low-hazard groups. Awards were based on safe, accident-free, working days. Everyone of the approximately 6000 employes in both the Bayonne and the Bayway works competed. The 100-day contest period was from Nov. 1, 1941 to Feb. 8, 1942.

Total prize money appropriated by the company was $3840, to be divided equally, $1920 for the Bayonne Refinery contest and $1920 for the Bayway refinery.

Each refinery force was divided into four groups made up of about the same number of employes but picked from various sections of the plant and from various types of work. Three-man committees appointed by the management represented the employes in each group on all matters pertaining to contest policy, scoring, methods of using prize money, and the like. The chairman of each group committee also served on a six-man central plant committee which included the plant safety supervisor and one other employe appointed by the management.

The contest was divided into five periods of 20 days each. During the first 20-day period each plant group reporting a safe day was credited with $1. If a disabling injury was charged against any employe in the group during that period, any money credited to the group was placed in the jack-pot for the whole division. The individual group then started from scratch again, insofar as money credits was concerned.

As soon as a group completed the first 20 days without a disabling injury, it automatically became eligible to receive credits of $2 per day for its next 20 safe working days. After passing the 40th day, it received credits of $3 per day for the 41st to the 60th safe days. For the 61st to 80th days, it received $6 per day, and for the 81st to 100th days, $12 per day.

A disabling injury charged against any plant group, no matter in which of the five periods it occurred, automatically sent all accumulated credits to the jackpot for that refinery, and required the group to start again at $1 per day for 20 days, then $2 per day for the next 20, etc.

At the end of the 100 days, each group was credited with the balance due for its contest performance. The money remaining in the refinery jackpot then was given to that group which had established the longest consecutive period of non-disabling injury days. It was up to the winning group's committee to decide how the prize money was to be distributed. They could hold a picnic, or purchase individual awards, but were not allowed to divide in cash.

Only Clear-Cut Cases Counted

For contest purposes only accidents clearly established as disabling injuries were considered. That eliminated cases where an injured employe was able to continue working but was later awarded compensation for permanent disability through claims subsequently allowed by law.

The four groups in each refinery were divided approximately equally numerically, and were set up so as to contain employes of equal risks on the average. For example, the Bayway refinery was set up as follows:

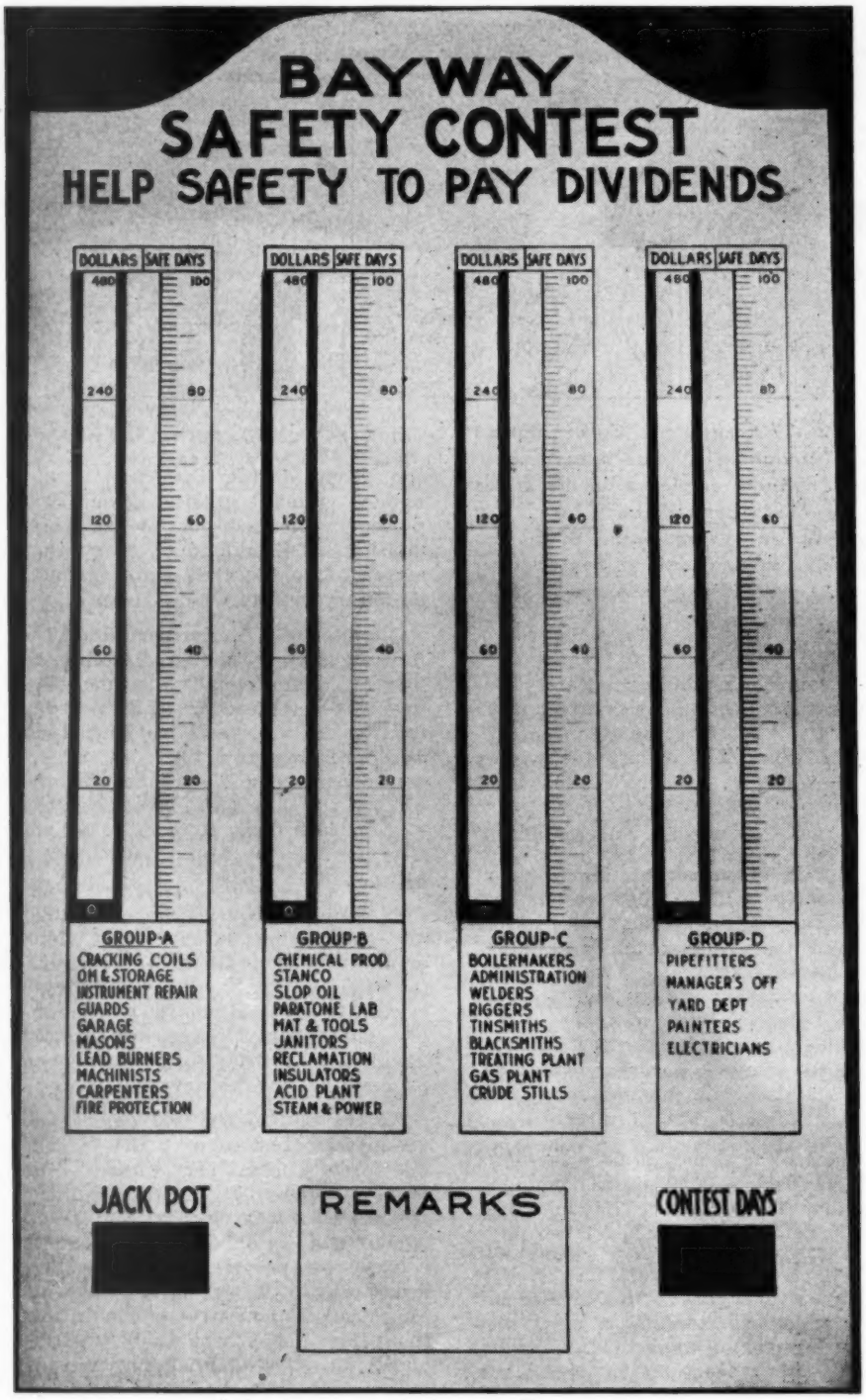


Fig. 3—Part of one of the many elaborate signboards Esso Standard used at the Bayway Works to publicize the "100 Day Safety Contest" during the winter of 1941-42

Group A (860 employes)—Cracking coils, oil movement and storage, instrument repair, guards, garage, masons, lead burners, machinists, carpenters, and fire protection.

Group B (855 employes)—Chemical products, Stanco, slop oil, Paratone laboratory, materials and tools, janitors, reclamation, insulators, acid plant, and steam and power.

Group C (861 employes)—Boilermakers, administration, welders, riggers, tinsmiths, blacksmiths, treating plant, gas plant, and crude stills.

Group D (866 employes)—Pipefitters, manager's office, yard department, painters, and electricians.

Typical of the many very elaborate posters used to publicized the Bayonne Refining contest is the one shown in Fig. 3. At the end of the contest, three groups had completed 100 days without a disabling injury. Final standings were as follows:

	Bayway Safe Days	Credits
Group A	100	$480
Group B	52	96
Group C	47	81
Group D	100	480

Groups A and D divided the jackpot of $161.

	Bayonne Safe Days	Credits
Group A	9	$ 9
Group B	100	480
Group C	11	11
Group D	25	30

Group B won the entire jackpot for its refinery which amounted to $584.

Groups A, C, and D at Bayway gave their prize money to the National Federation for Infantile Paralysis, Inc. Group B decided to buy as many $25 War Bonds as they could and raffle them off. At Bayonne, each group also purchased War Bonds and raffled them off. Any excess money was also donated to the paralysis fund.

This brief review of the 28-year record of safety at Esso Standard Oil Co. has been brief and has touched only a few of the historical highlights. The entire program for accident prevention is a complete one. It includes all the conventional routine metal and equipment inspections by trained engineers under the supervision of C. J. Luz, assistant chief safety engineer in charge of metal inspection.

Check New Processes

In addition to these regular scheduled checks, a policy has been established whereby new processes, while still in the preliminary flow diagram stage, are reviewed by a joint committee composed of members of the Safety Department and the Engineering & Process Design Division.

A flow plan is drawn up and studied from start to finish, noting all substances handled, reactions involved, provision for safety relief valves, temperature and pressure conditions, and the extent to which corrosion resistant materials will be used.

Future safety activities at Esso Standard will be based on three plans of action—use of tried and proved methods, use of new methods, and a program to prevent accidents beyond the plant. It is obvious safety's job is far from finished. Safety at Esso is not a stationary program; it is a dynamic activity, constantly trying new stunts, new methods, new approaches. The point to remember in selling safety, authorities agree, is that the prospective buyers—the workmen—are not an audience but a parade.

Acetylene Produced by Cracking Methane In Regenerative-type Reaction Furnace

In a German process, methane is cracked in a regenerative-type reactor at 1400-1600° C., at 0.1 atm. ab. pressure, to produce acetylene. Recovery of approximately 36% acetylene is reported. Necessity for conducting the reaction at low absolute pressure is reported as the chief disadvantage of the process. Based on successful pilot plant operation a commercial plant was designed but was not built because the war ended.

A PROCESS for the manufacture of acetylene by conversion of methane in a regenerative-type furnace was developed successfully through the pilot plant stage by Ruhr-Chemie Holten, in Germany, and a large commercial plant was designed to be built in Hungary when the war ended. Methane is used for heating the furnace as well as for the feed gas for the reaction.

The process is described in a report by O. G. Direnga and P. J. Leaper, of the U. S. Department of Commerce Technical Industrial Intelligence Division, and issued by the U. S. Military Government in Germany. The purpose was to provide data to permit the evaluation of this process in comparison with other methods for manufacturing acetylene which were used in Germany. These were generation from carbide, generation from hydrocarbon gases either by thermal cracking or by means of an electric arc, or generation by partial combustion of methane with oxygen.

The process operates on a one-minute heating and one-minute reaction cycle, methane being reacted at

Fiat Final Report No. 1079. "The Production of Acetylene from Methane in a Regenerative-Type Furnace, Ruhrchemie Aktiengesellschaft, Oberhausen-Holten", by O. G. Direnga and P. J. Leaper, Technical Industrial Intelligence Division, U. S. Department of Commerce.

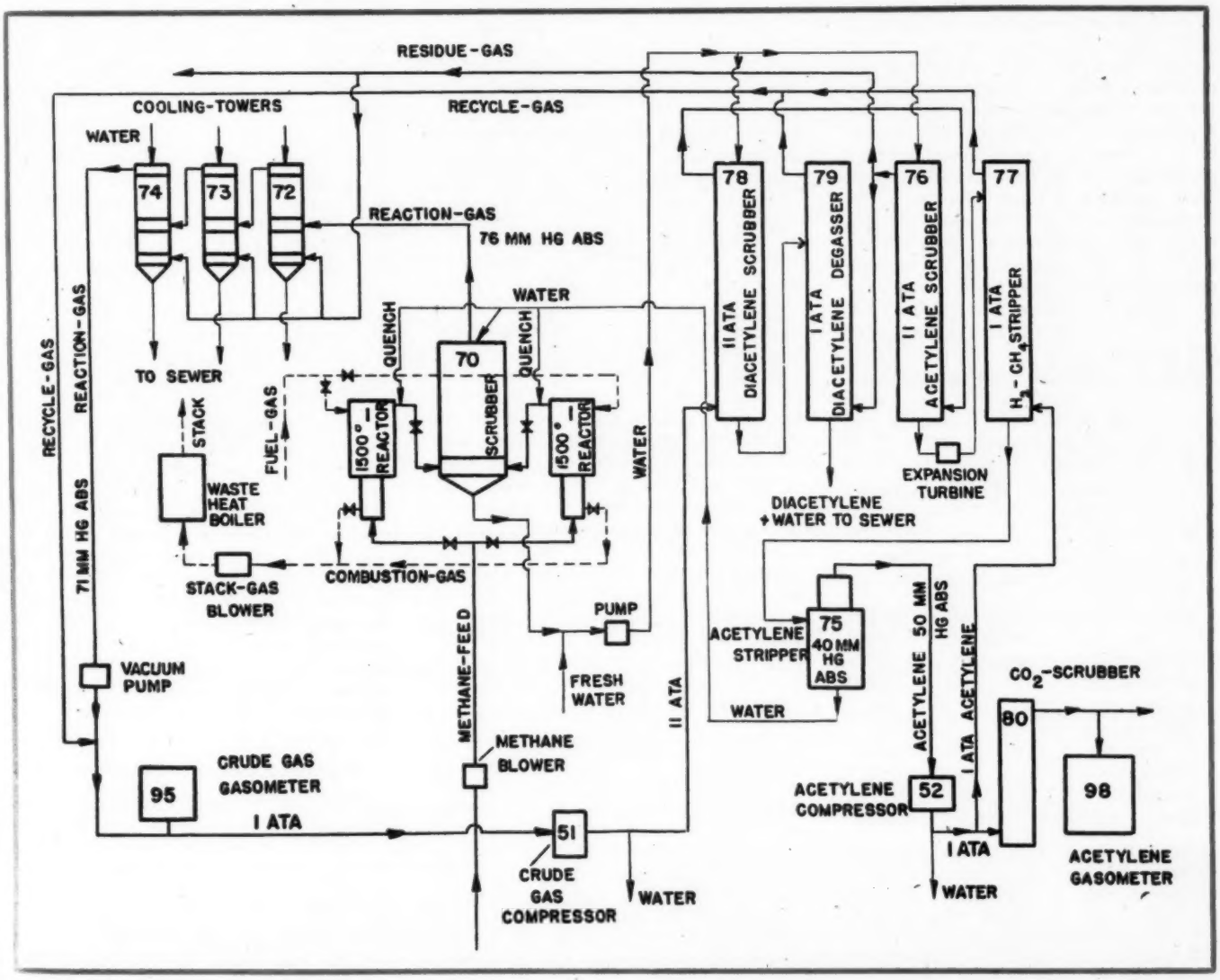


Fig. 1—Simplified flow diagram for Ruhr-Chemie process for the production of acetylene in a regenerative type furnace

temperatures of 1400-1600° C., at 0.1 atmosphere absolute pressure. It was found that about 36% of the reaction methane is converted to acetylene, 36% cracked to carbon and hydrogen, and 28% remained unchanged. The ratio of acetylene to carbon formation depends critically upon the reaction pressure, even a slight increase of the pressure shifting the ratio in favor of carbon formation.

On the basis of data obtained from laboratory experiments as well as from pilot plant operation it was concluded than an absolute pressure of 76-80 mm. Hg and a temperature of 1400-1500° C. represents the practical optimum conditions for the commercial production of a reaction gas fairly rich in acetylene.

Low Pressure Disadvantage

"The necessity of conducting the reaction at the low absolute pressure of 76-80 mm. Hg is the chief disadvantage of the process", states the report. "The reaction gases must be cooled and washed free from dust with water in a series of washers. In order to avoid excessive solution of C_2H_2 in the water, this preliminary purification is carried out at the reaction pressure. This obviously necessitates very large size equipment for the preliminary purification and, furthermore, the power requirement of the vacuum pump forms a high percentage of the manufacturing cost. This condition is made even more unfavorable, because the reaction gas after its preliminary purification must be compressed to 11 atmospheres absolute for the recovery of acetylene, so that a compression ratio of 11 to 0.1 or 110, exists over the system".

Under optimum operating conditions the true gas velocity is approximately 100 m./sec., measured at the temperature and pressure of the reaction. The reaction time is 1/100 sec. The decomposition of the methane feed gas results in the following two reactions:

(a) $2\ CH_4 + \Delta \longrightarrow C_2H_2 + 3H_2$
(b) $CH_4 + \Delta \longrightarrow C + 2H_2$

The product gas from the decomposition has the following approximate percent volume composition:

Methane	15.7
Acetylene	9.8
Diacetylene	0.3
Hydrogen	70.7
Nitrogen	<3.1
Oxygen	<0.1
Carbon dioxide	0.4

The off gases from the diacetylene stripper and from the methane gasser, shown in Fig. 1, which are rich in acetylene, are recycled and mixed with crude reaction gas in the recovery of acetylene.

The reaction, preliminary purification by washing, and the purification system are described as follows in the report:

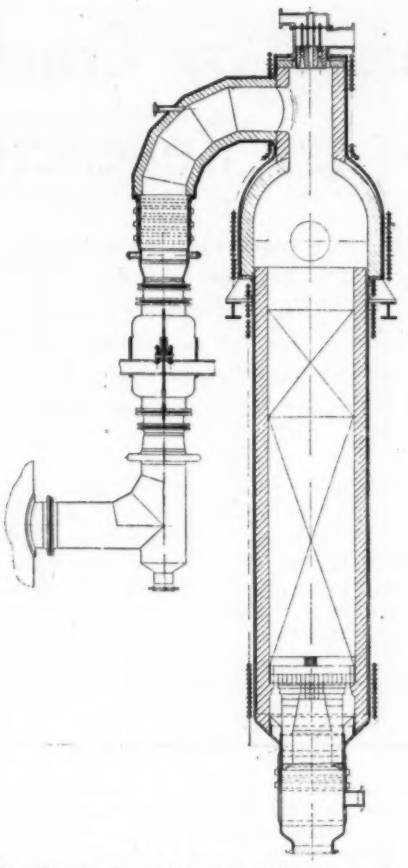


Fig. 2—Design of regenerative-type reaction furnace used in Ruhr-Chemie process for production of acetylene from methane

"Since the operation is an intermittent one, on a one-minute cycle, two reactors are provided, so that the vacuum pump may be operated at a uniform load. Automatic switching of the gas valves is provided for in the design of the large scale plant.

"The lower two-thirds of the reactor (Item 1 in Fig. 1) are filled with non-porous firebrick or sillimanite plates of a rectangular shape, the upper one-third is filled with similar plates of a dense, non-porous aluminum oxide. The top of the reactor is provided with several burners, in which methane is burned for the purpose of pre-heating the reactor. (see Fig. 2)

Use Downflow

"The combustion gases travel down the reactor, and thence through a waste heat boiler, and a stack gas blower to the stack. In the downward travel of the combustion gases the upper portion of the reactor will, of course, be heated to the highest temperature. The equipment is designed to allow enough heat to be absorbed by the packing in one minute of heating to supply the necessary heat of reaction for the one-minute reaction cycle. During the heating period, the reactor is under atmospheric pressure.

"In the change over to the reaction cycle the reactor is automatically connected to the vacuum system, and methane is now expanded into the bottom of the unit at 76-80 mm. Hg absolute pressure. The gas in its passage through the lower two-thirds is preheated to approximately 1,200° C. It then enters the hottest zone, which contains the aluminum oxide plates, where it is heated to the reaction temperature of approximately 1,500° C. The decomposition of methane takes place in this upper zone, the heat of reaction being furnished by the heat capacity of the aluminum oxide plates.

"It is an interesting feature of the process that more than 90% of the carbon formed in the cracking operation is deposited on the packing, so that very little carbon dust is carried away by the reaction gas. The combustion of this carbon furnishes a considerable portion of the heat required in the subsequent heating cycle, approximately 37-39% of the total heat.

"In this respect, the Ruhr-Chemie process differs essentially from the Electric Arc process in which carbon formed is recovered from the exit gas stream.

"The reaction gas is quenched immediately upon leaving the reactor by a number of water sprays in the gas header, and then enters the bottom of the preliminary scrubber, where carbon dust is washed out and the gas is further cooled. The water effluent from this scrubber is subsequently used, after clarification, in the diacetylene and acetylene scrubbers (items 78 and 76) in order to recover acetylene dissolved in this water.

"From the preliminary scrubber the reaction gas passes through three Raschig ring packed cooling towers arranged in series, in which the gas is still further cooled by counter current water flow to a temperature of about 25° C. The water effluent from these cooling towers is stripped in the lower section of the cooling tower with acetylene-poor residue gas obtained from the acetylene scrubber (item 76) in order to displace dissolved acetylene. The water is then discharged through a barometric leg and seal tank to the sewer.

Compressed Before Crude Reaction

"The washed, cooled, and moist gas from the coolers now enters the vacuum pump in which it is compressed to atmospheric pressure and pumped to the crude reaction gas gasometer. The crude gas, on the dry basis contains about 10% of acetylene.

"The gas from the gasometer is compressed to a pressure of 11 atmospheres absolute by means of a

what products . . . what quantities . . . what grades do You want?

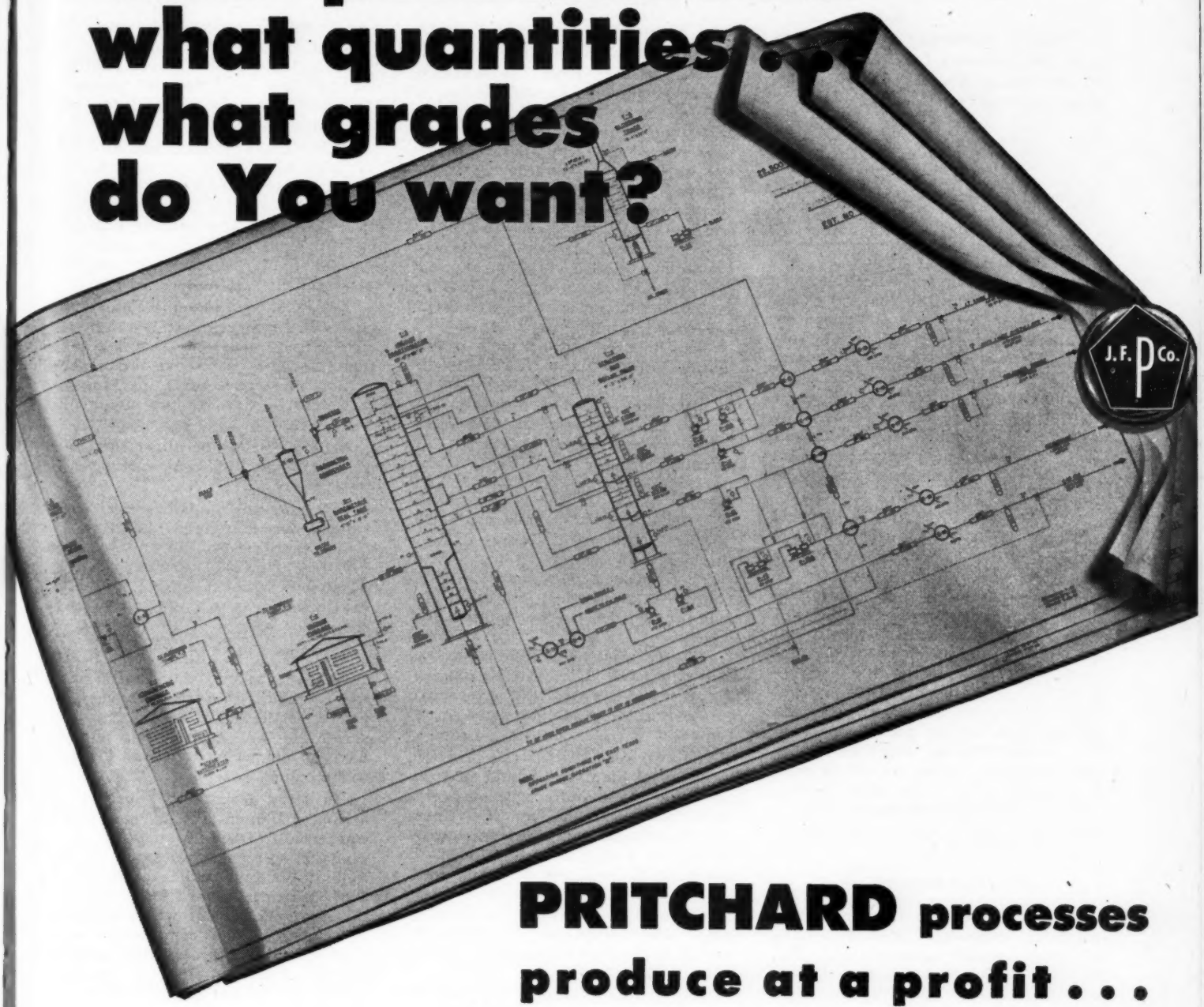


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TABLE 1—Dimensions of Regenerative-Type Reactors for Decomposition of Methane to Produce Acetylene, for Proposed Plant for Hungary

	mm.
I.D. of packed space	1200
Fire brick wall, thickness	80
Inner shell, thickness (Sicromal)	6
Air-space, thickness	10
Outer jacket, thickness (Steel)	10
Total height of packing	4200
Height of Al_2O_3 plates in upper third	1200

piston-compressor. The first step in the purification is the removal of diacetylene, which is accomplished by scrubbing the crude gas countercurrently with a small amount of water in a scrubbing tower (item 78). The solubility of the diacetylene is about four times that of acetylene. The water for scrubbing is the effluent from the preliminary scrubber (item 70) directly downstream from the furnace.

"The effluent from the diacetylene scrubber (item 78) is now expanded into the diacetylene degassing tower (item 79) to a pressure of one atmosphere absolute. Residue gas, free of acetylene, is blown into the bottom of this tower at such a rate that all of the dissolved acetylene, but only about 25% of the dissolved diacetylene is stripped off. The gases from this tower are recycled to the suction side of the gas compressor. The water effluent, which is free of acetylene, but carries with it in solution about 75% of the total diacetylene, is discharged to waste. No efforts have been made to date to recover the diacetylene.

Scrubbed With Water

"The off gas from the diacetylene scrubber, consisting of C_2H_2, CH_4, H_2 and small amounts of N_2, O_2, and CO_2, but which is free of diacetylene, is now scrubbed with a large amount of water in the acetylene scrubber (item 76) under the system pressure of 11 atmospheres absolute. Again, the water effluent from the preliminary gas scrubber (item 70) is used, and deficiencies are made up with fresh water.

"The acetylene and carbon dioxide are scrubbed out and leave this unit in the water effluent.

"The residual off gas from this tower, consisting of CH_4, H_2, N_2 and O_2 is collected in a gasometer. A portion of this gas, however, is used to strip dissolved acetylene from the water effluent of the preliminary cooling system (items 72, 73 and 74). Another portion of this gas is used to strip acteylene from the water effluent of the diacetylene degassing tower (item 79), (as previously mentioned). Still another portion of this gas is mixed with fresh methane for the purpose of preheating the reactor. The balance of this gas is utilized for other manufacturing purposes.

"The effluent from the acetylene scrubber, which carries in solution the bulk of the acetylene, carbon dioxide, and some hydrogen and methane, is now expanded through a turbine into the top of the hydrogen-methane stripper (item 77) to a pressure of 1.0 atmosphere absolute. Hydrogen and methane are removed practically to completeness by blowing pure acetylene into the bottom of the stripper. The off gas from this tower is recycled and mixed with crude reaction gas.

"The bulk of the acetylene which, together with carbon dioxide, is dissolved in the water effluent of the hydrogen-methane stripper (item 77) is now expanded into the two acetylene degassers (item 75) to the low pressure of 40-50 mm. Hg absolute. Acetylene and carbon dioxide are thereby stripped from the solution. The moist gas is compressed to atmospheric pressure, carbon dioxide is scrubbed out in a scrubbing system with potassium carbonate solution (regenerative system) and the acetylene product gas is collected in a gasometer.

"The water effluent from the acetylene degassers is utilized for quenching the hot furnace exit gases and for feeding the preliminary gas scrubber (item 70)."

The two reactors for the proposed commercial plant to be built in Hungary for the manufacture of acetylene from methane by the Ruhr-Chemie, Holten, process, were designed for a flow rate of 515 cu. ft. per hour of methane for each unit. Dimensions, given in Table 1, were proportional to the Ruhr-Chemie pilot plant. The design for the regenerative-type reactors is described as follows in the report:

"The lower 3000 mm. of packing consisted of firebrick (Sillimanite) of rectangular shapes, set on edge. The size of the plates was 7 mm. × 80 mm. × 150 mm. The upper 1200 mm. of packing consisted of plates of identical size made of a dense, nonporous aluminum oxide.

"The lower packing had a weight of 6000 kg. This lower zone has the function of preheating the reaction gases to 1200° C; it was calculated that the mean temperature charge in the packing of the preheat zone would be 14° C., based on a specific heat of the packing of 0.2.

"The gas is further heated from 1200° C. to approximately 1500° C. in the upper zone. The reaction takes place between the above temperature limits. The upper Al_2O_3 packing had a weight of 2000 kg. per meter, or a total weight of 2400 kg.

"The mean temperature change of the Al_2O_3 packing was calculated at 55° C.

"The packing in both zones is arranged in staggered fashion, the plates standing on the 80 mm. edge. The free-cross-sectional area is 30%. This arrangement gives maximum heat capacity with minimum pressure drop.

Final Form Never Settled

"It appears that the final form of the reaction furnace was never definitely settled. An early design is shown in Fig. 2. This unit did not have an air jacket, but was provided with cooling coils.

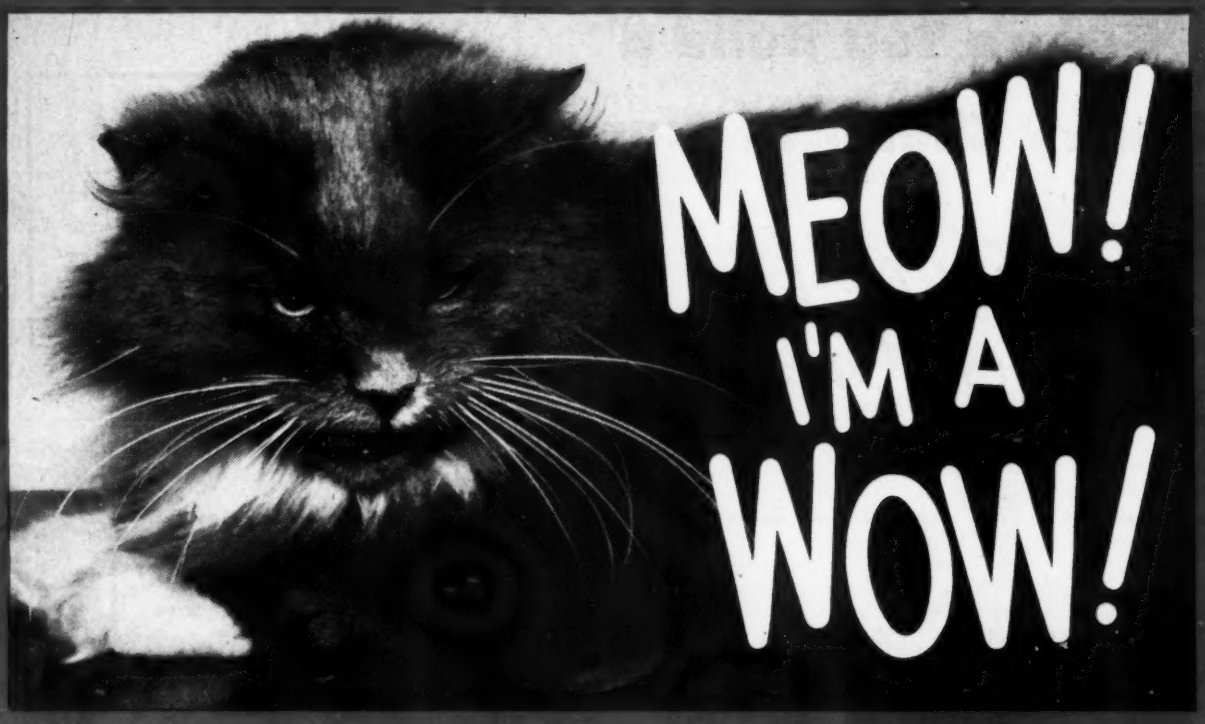
"In later designs the burners are arranged tangentially around the circumference of the top of the furnace. Combustion air is admitted at the bottom of the unit and is preheated to 300° C. in its upward travel through the air-jacket, from which it enters the burners. The combustion gases flow downward through the packing. During the reaction-cycle, methane enters at the bottom and flows upwards."

Correction

K. C. Bottenberg, chairman of the Motor Fuel Subcommittee of the Technical Committee of the Natural Gasoline Assn. of America, has called attention to a statement in the article in the January PETROLEUM PROCESSING describing the Nowata vapor lock tests in which it was said, "The economic significance of the conclusions that can be drawn from the tests has been overlooked".

What was meant was that the importance of this test work and the economic significance of the conclusions that could be drawn from it had not been emphasized strongly enough to the industry at large. The committee itself in its final report published by the NGAA brought out that increasing the Reid vapor pressure of winter motor fuels from 13 to 15 pounds in those states and for the months where the average daily maximum temperature is 55° F. or lower, represents a potential market for about 9,000,000 bbls. of normal butane per year based on 1946 consumption data.

Increasing the over-all volatility of winter motor fuels for the same area and period mentioned above using 30% additional 12-lb. Reid vapor pressure volatilizing agent provides a potential outlet for about 54,000,000 bbls. of material of this type, the report brings out.



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* For recent developments in the Perco Cycloversion Process, see the December 13th, 1947, issue of *Oil and Gas Journal*

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Method for the Direct Determination of Oxygen In High-Molecular Weight Organic Compounds

AN IMPROVED laboratory technique for the determination of oxygen directly, rather than by difference, in high-molecular weight organic compounds has been developed by Messrs. W. W. Walton, F. W. McCulloch, and W. H. Smith of the National Bureau of Standards in Washington, D. C.

By this new method, small amounts of oxygen, such as occur in mineral oils, in natural and synthetic rubbers, and in plastics prepared from hydrocarbons, can be measured with precision and accuracy, it is reported.

Essential features of the procedure are (1) thermal decomposition of the sample in an atmosphere of oxygen-free helium, and (2) conversion of the resulting oxygen compounds to carbon monoxide by passage of the products over carbon at 1120° C. The oxygen content of the material is then calculated from the %-vol. of carbon monoxide in the collected gas, as determined by the National Bureau of Standards Carbon Monoxide Indicator.

The apparatus is shown in the accompanying photograph. It consists primarily of a helium tank with pressure regulator, a furnace at 400° C. packed with copper spirals through which the helium is passed to remove oxygen, a U-tube filled with ascarite and a drying agent to absorb carbon dioxide and moisture from the helium, a quartz tube having a section packed with carbon pellets, a tubular furnace enclosing that section of the quartz tube and heated to 1120° C., and a flask of accurately measured volume in which the carbon monoxide is collected.

The apparatus is arranged so that a continuous stream of helium is passed over the heated copper and through the drying agents into the quartz tube. After the weighed sample has been placed in the entrance end of the tube on a platinum boat, air is swept out of the system by means of a reverse stream of heated helium for two hours. The flow of helium is then directed forward through the high-temperature furnace toward the collecting flask.

The sample is burned by slowly advancing a Bunsen burner and a gauze mantle along the section of the quartz tube containing the platinum boat. This operation, requiring about 10 minutes, is repeated to insure complete decomposition of any particles that may have sublimed to other parts of the tube.

The products of pyrolysis pass with the helium over the hot carbon in the furnace and through a liquid air trap to the collection flask, where water is gradually displaced by the mixture of gases. After a given volume of gas has been collected, as measured by the water level in a capillary, the collecting flask is disconnected and a stopcock opened momentarily, allowing a small amount of air to flow into the flask to restore atmospheric pressure.

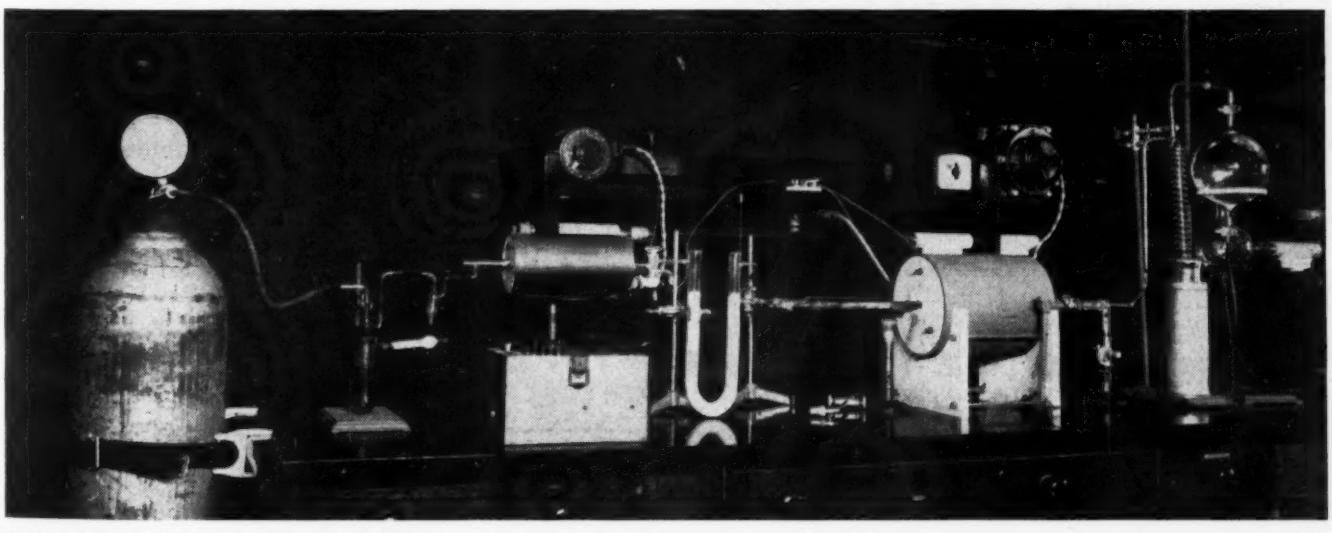
To determine the percentage by volume of carbon monoxide in the collected gas, the flask is connected through a flow meter to an NBS carbon monoxide indicating tube. The tube contains a colorimetric indicating gel capable of detecting and estimating less than 1 part of carbon monoxide in 500 million parts of air.

After the gas has passed through the tube at the rate of 70 ml./minute for a definite period, the color shown by the indicating tube is compared visually with standard tubes prepared at the same time by passing known amounts of carbon monoxide through them. From the value obtained for the volume concentration of carbon monoxide in the collected gas, the volume of the gas (known by previous calibration of the flask), the density of carbon monoxide, and the weight of the sample; it is possible to calculate the percentage of oxygen in the material.

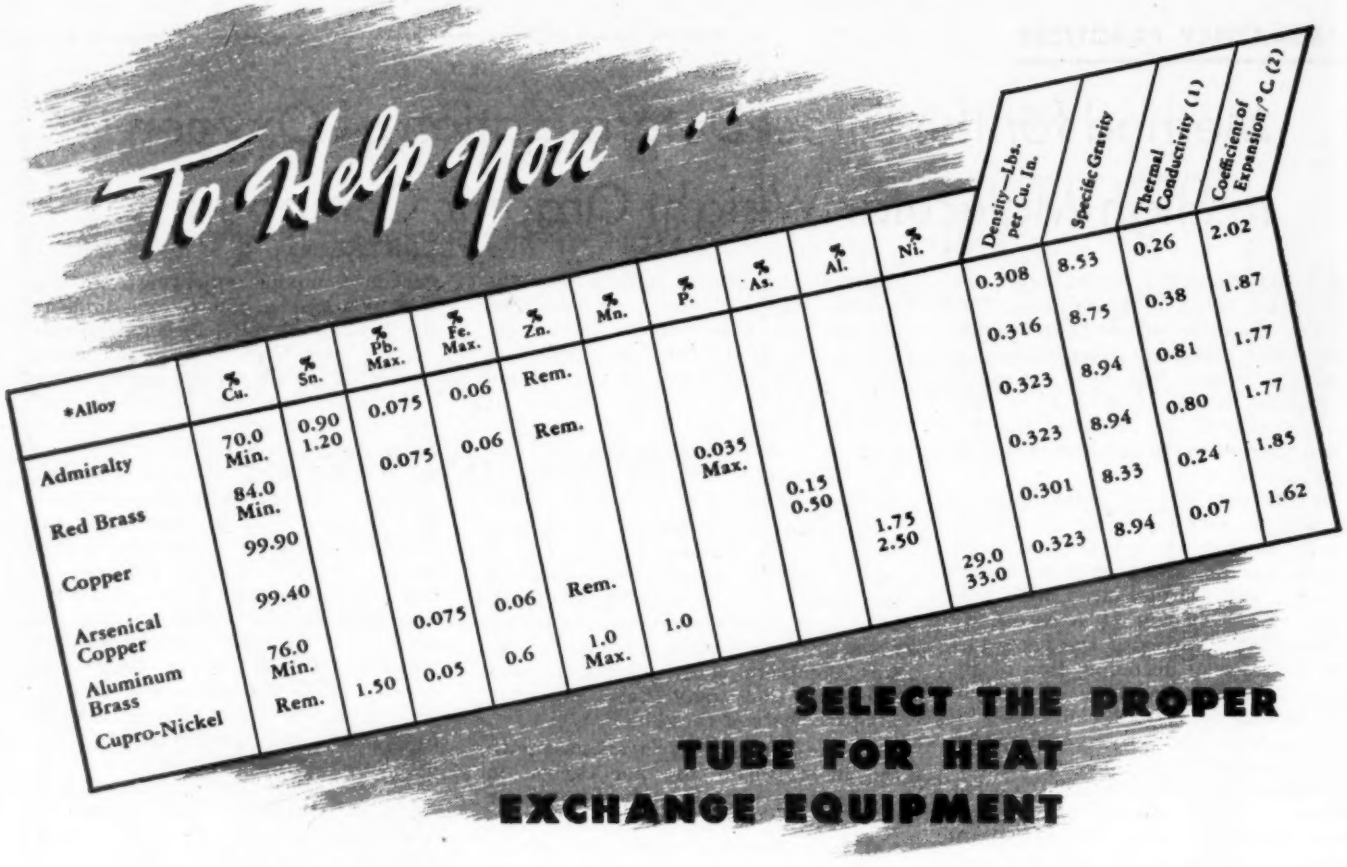
This method has been used with excellent results at the Bureau in the analysis of compounds containing less than 2% of oxygen, it is stated; and it is expected that with some modification, the procedure may be used in the analysis of materials containing higher percentages of the element.

In the conventional methods of organic analysis, oxygen contents have always been determined by difference after the amounts of elements other than oxygen had been determined directly. The value for oxygen obtained in this way involves an accumulation of possible errors in the other determinations, but it has proved reasonably satisfactory in investigations of the structures of compounds of low molecular weight.

However, for the analysis of compounds of high molecular weight or of those containing very small amounts of oxygen, greater accuracy becomes a requirement.



Apparatus developed at the National Bureau of Standards for direct determination of small amounts of oxygen in organic compounds. From left to right: helium tank, furnace for oxygen removal CO_2 and moisture removal tube, quartz tube for burning of sample, conversion furnace, and gas-collector



*Alloy	% Cu.	% Sn.	% Pb. Max.	% Fe. Max.	% Zn.	% Mn.	% P.	% As.	% Al.	% Ni.	Density—Lbs. per Cu. In.	Specific Gravity	Thermal Conductivity (1)	Coefficient of Expansion/°C (2)
Admiralty	70.0 Min.	0.90 1.20	0.075	0.06	Rem.						0.308	8.53	0.26	2.02
Red Brass	84.0 Min.		0.075	0.06	Rem.		0.035 Max.		0.15 0.50		0.316	8.75	0.38	1.87
Copper	99.90										0.323	8.94	0.81	1.77
Arsenical Copper	99.40			0.075	0.06	Rem.				1.75 2.50	0.323	8.94	0.80	1.77
Aluminum Brass	76.0 Min.			0.05	0.6	1.0 Max.	1.0				0.301	8.33	0.24	1.85
Cupro-Nickel	Rem.		1.50							29.0 33.0	0.323	8.94	0.07	1.62

Here is a list of a few of the important alloys available from Wolverine—with a brief description of their principal applications:

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ALUMINUM BRASS—the uses are similar to admiralty. However, it is considered superior to admiralty for highly polluted or brackish water conditions. It is superior where there is erosive and corrosive conditions. The success of the alloy is due to a thin continuous protective film being formed on the metal surface in service. Should abrasion or erosive conditions cause a break on the surface of the tube, the aluminum brass has the property of self healing which means continuous protection to the metal surface.

CUPRO-NICKEL—is used in heat exchange equipment where corrosive conditions are very severe, where high temperatures, erosion and high velocity of cooling water are encountered.

Send for more specific data on any of these or other alloys in which you may be interested to meet your particular requirements.

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Pneumatically Operated Tools Reduce Time Needed to Clean Ports in Gas Compressors

POWER cylinder ports on some gas compressors frequently become fouled with carbon, requiring the removal of each cylinder in order to get at the fouled port openings for cleaning. This job on a six cylinder gas engine normally takes 24 hours downtime, and 128 man-hrs. in labor charges.

Ignatius Treat, a machinist at Humble Oil & Refining Co.'s Baytown synthetic rubber plant, decided the job could be done with special tools of his own design in one-third the time. He developed four tools to fit a small standard pneumatic hammer. They have chisel-sharp edges, designed to conform roughly to the contours of the surface being cleaned, and they have long, bent shanks.

Tools, air-hammer, and a light are shown in Fig. 1. Treat, on the job, is seen in Fig. 2. Point "A" indicates the opening on the cylinder from which the gas valve has been removed. Light and tool are both inserted in this opening. The fouled ports are illuminated and readily accessible to the tool held in his left hand. Formerly, it was necessary to remove the entire cylinder head at point "B" to get at the ports for cleaning.

The Baytown plant had to remove each of its compressors from service every six months for port-cleaning in the past. Now they are cleaned every 90 days, but the unit is out of service only eight hours, and the only labor required is that of two machinists. Labor cost has been reduced to one-sixth. In addition, no rigging operation is needed since the heads are not disturbed.

Fig. 1—Port-cleaning tools for gas compressors. Small pneumatic hammer at "A", and a small light at "B", both of which are standard toolroom equipment. Specially designed tools are at "C"

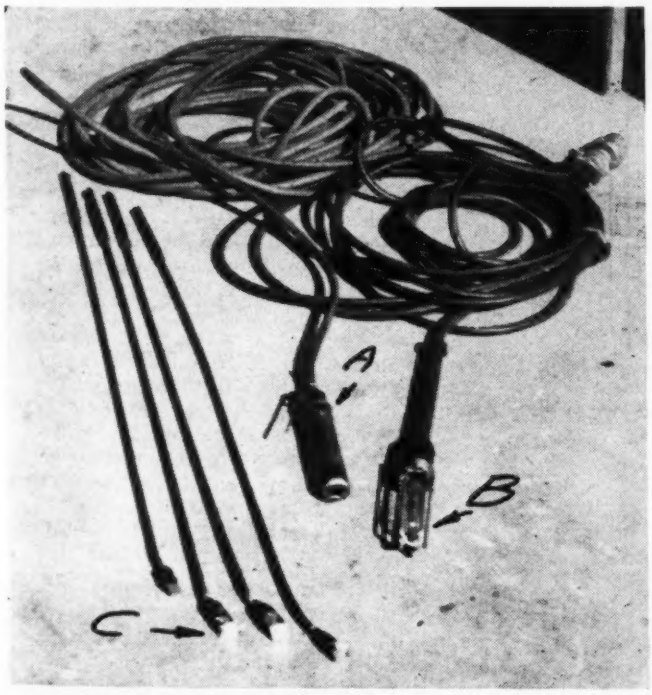

Fig. 2—Tools in use on a gas compressor cylinder. Gas valve has been removed from opening "A", light and pneumatic tool inserted. Former method required removal of cylinder head at "B"

Worn Tube Sheets Are Salvaged With a Stainless Steel Facing

By JOHN C. ALBRIGHT

CONDENSER or exchanger tube sheets have been salvaged and the life of the equipment materially lengthened by facing the old carbon steel sheet with stainless-steel at the Norwalk, Calif., refinery of Wilshire Oil Co.

The tubes are removed and the old sheet is placed in a lathe, cleaned up and trued. A plate of stainless steel, approximately ½ in. thick, is then cut so that its outside diameter

is slightly larger than the area occupied by the tube holes.

The plate is then welded carefully with stainless steel rod to the tube sheet so as to obtain a liquid and gas tight joint. Next a stainless steel ring, also ½ in. thick, is cut with outside diameter equal to that of the tube sheet and its inside diameter equal to the O.D. of the previously cut plate.

This ring is then welded along both inside and outside edges to the tube sheet and concentric with the plate. The finished new surface in then trued again on a lathe, and holes bored through for rolling in new tubes.

Plug Cocks Reconditioned at 2/hr. Rate With Lapping Machine Made from Scrap

BUILT from scrap materials, a specially-designed lapping machine in the valve shop at the Marcus Hook refinery of Sun Oil Co. reconditions huge plug cocks in less than an hour where previous hand methods required two or more men working anywhere from two to three days.

Plug cocks from HF alkylation units collect fluorides on the inner surfaces, making them stick solidly, and requiring considerable man power with hand-lapping methods. Faced with turning out a large number of valves on a rush order, Sun's valve shop personnel developed and built the lapping machine, shown in the simplified sketch in Fig. 1.

The framework is angle iron and sheet iron, about 6 ft. high by 2-1/2 ft. square. In operation, the plug cock is anchored securely at the center of the base. The valve stem is connected through a universal joint to the vertical shaft, which is rotated at about 60 rpm by means of the gear drive assembly at the top of the frame.

A horizontal shaft, belt-driven by a small motor and carrying an eccentric cam, applies an up-and-down motion to the vertical drive shaft (about 3/4 to 1 in. range). The universal joint insures perfect center alignment for the plug during lapping. Lapping compound is poured into the valve at the top as shown.

Sun's valve repair men stated they can complete a lapping job on a 6 or 10 in. plug cock in 30 to 45 minutes, depending on the extent of grinding needed. Larger cocks require slightly longer lapping time.

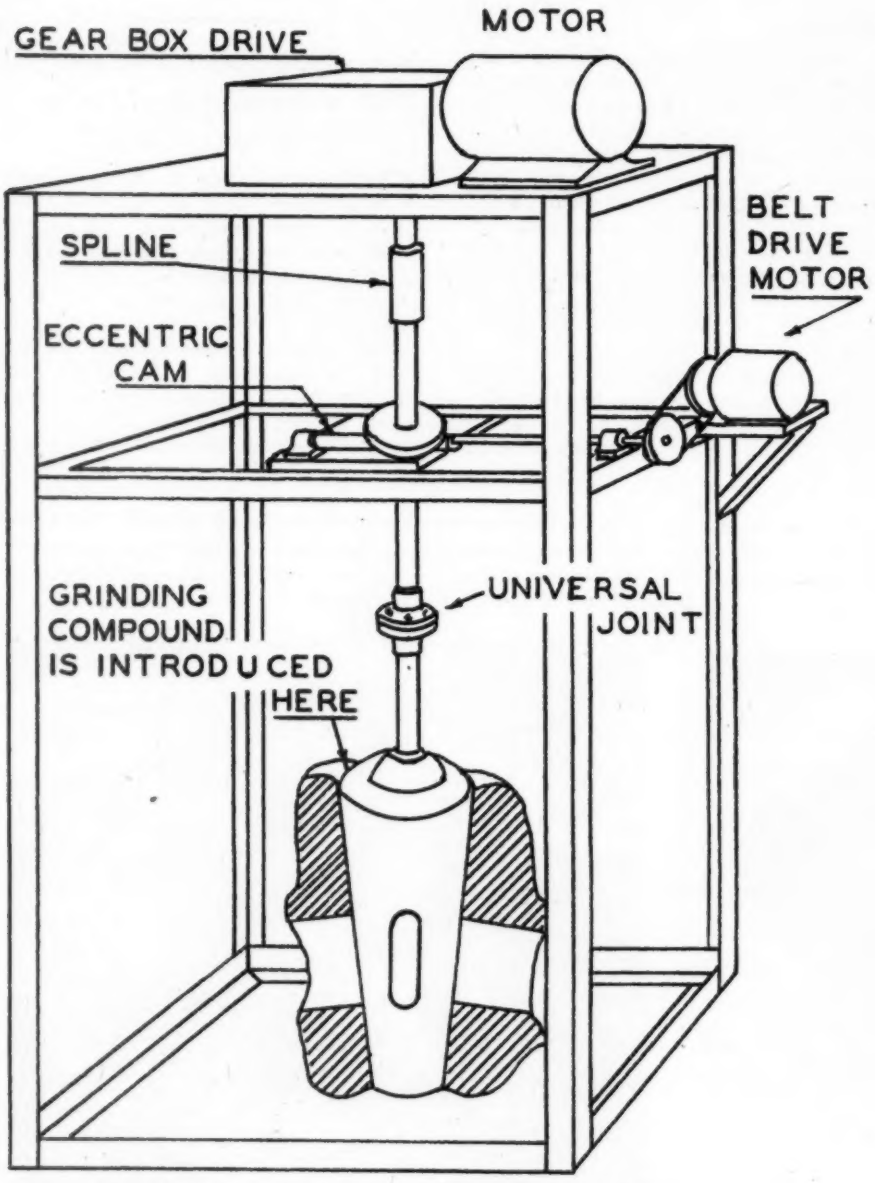

Fig. 1—Simplified sketch of plug cock lapping machine built by Sun Oil valve repair men, which eliminated tedious, back-breaking hand methods used previously

Has Plant Practices Helped You?

Or have you made a better gadget based on one from these pages? One reader reported recently that he used an idea from the September, 1947, issue for a tool to remove collector channel supports. That idea came originally from a machinist at the Torrance, California, refinery of General Petroleum Corp.

Another reader intends to build a portable tank scaffold similar to the one described in the October, 1947, issue, and developed at the Wood River refinery of Shell Oil Co. Perhaps you've had a similar experience—or maybe you've improved the design on some recent Plant Practices scheme.

Why not write in and tell us about it? Include photographs, drawings, or charts, if you have them. Material submitted for publication exclusively in PETROLEUM PROCESSING is paid for at the usual space rates. The idea is the thing—we'll dress up the drawings and the written information. Send your ideas to:

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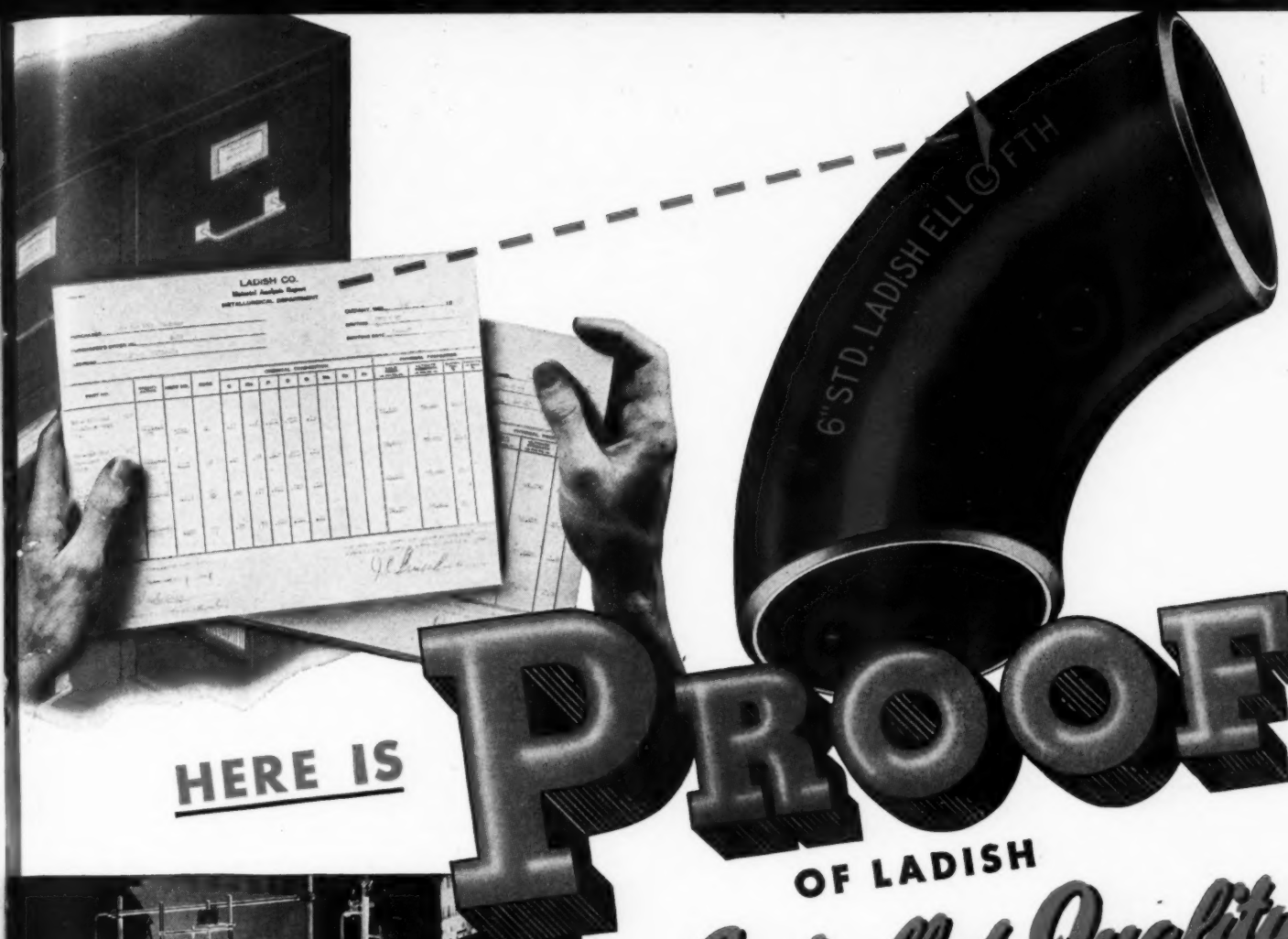

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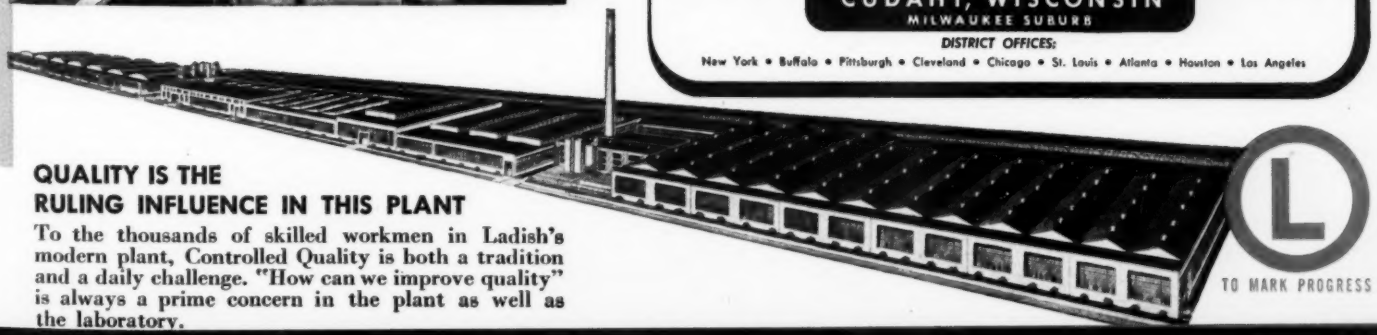

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"TWIN" CYCLING PLANTS SAVE MILLIONS OF BARRELS

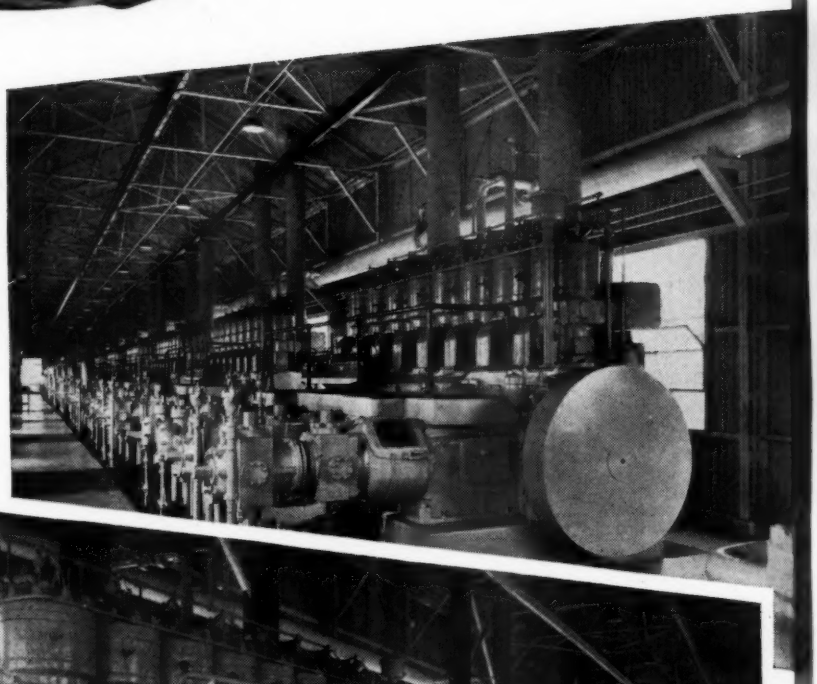
California Company Employs CLARK Compressors in Two New Conservation Projects...

Two new cycling plants operated by the California Company, one at Lake St. John, La., and the other at Cranfield, Miss., are "identical twins", although entirely independent in operation.

In each plant, 9 Clark 800 B.H.P. Right Angle Compressors pump dry gas back into the sands at 4,000 pounds pressure per square inch. It is estimated that these two conservation projects will effect a combined saving of 45,000,000 barrels of crude oil and condensate which these fields would otherwise have lost.

Each plant was developed under a voluntary unitization plan, by which each operator and royalty owner receives a percentage of the revenue from the entire field proportionate to his recoverable reserves.

Write for further information on this modern method of increasing yield which has been described as 'just like discovering a new oilfield'.



"Twin" installations of Clark Right Angle Compressors pump dry gas back into the sands at two new cycling plants operated by the California Company. One is at Lake St. John, La., and the other at Cranfield, Miss.

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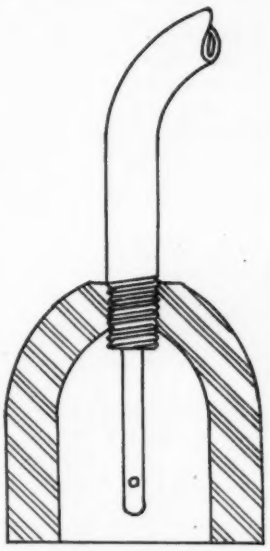
Mercury Saver

Loss of mercury in an orifice meter, due to blow-out from an excessive pressure differential across the orifice can be prevented by the simple device shown in the drawing.

Developed by a Humble Oil & Refining Co. machinist, it consists of a piece of 5/16 in. O.D. steel tubing, 3¾ in. long, threaded at one end. The other end is welded shut and a 3/16 in. orifice is drilled through both walls near this end. The nipple is screwed into the inlet line to the mercury trap as shown in the upper view. The tiny opening has a throttling effect on pressure surges and thereby prevents mercury blow-out.



Turntable Provides for Downhand Welding, Is Used Constantly Because of Time Saved

By JIM WALLEN, Ashland Oil & Refining Co.

A turntable which enables a welder to work in a down hand position at all times is in constant use at the Ashland Oil & Refining Co.'s No. 2 refinery welding shop because of the valuable time it saves on otherwise awkward welding jobs.

Originated by the foreman, and built with the assistance of the weld shop crew, the machine was constructed of salvaged materials originally destined for the junk heap. It is shown in the photograph.

The turntable comprises a flat steel disc with holes drilled in it along four radii at right angles to each other so that various shapes and sizes of work can be held. The disc is welded to a short shaft held in place by a discarded lathe chuck. The chuck in turn is attached to the main drive shaft and rotated by an air motor.

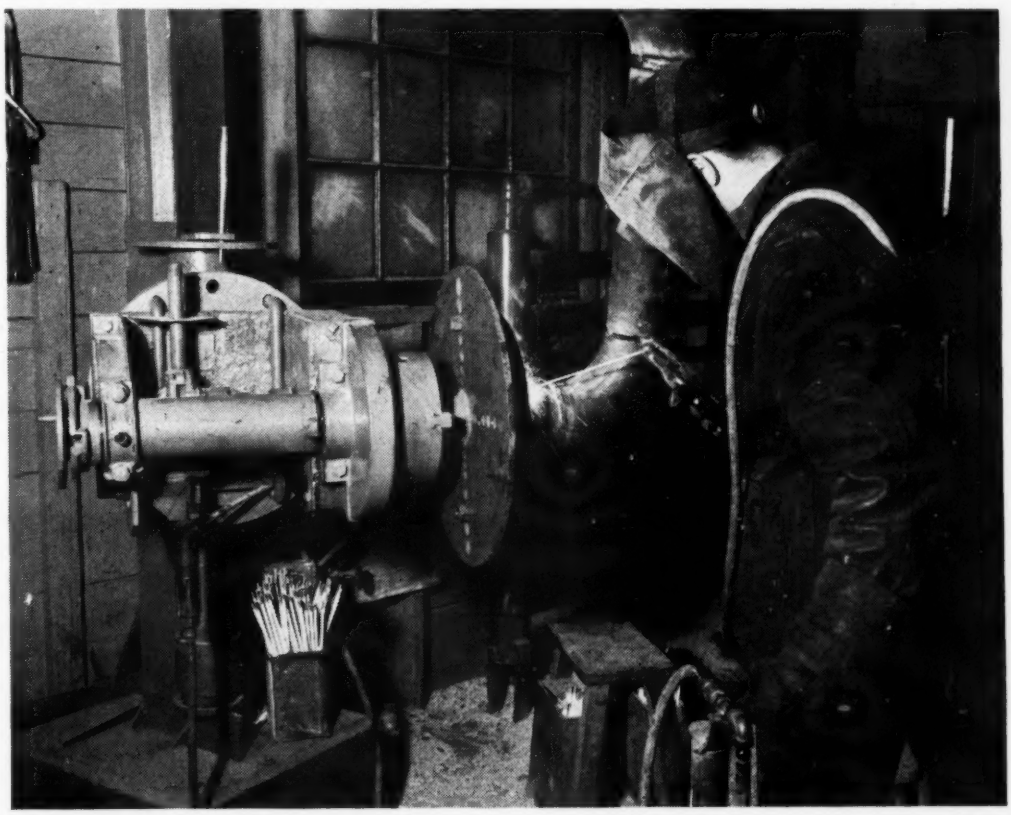
The entire assembly, motor, turntable, etc., is secured to a vertical swivel post, which is rigidly supported on an I-beam pillar set in a concrete foundation. Thus the unit can be swung into whatever position is best suited for the job at hand.

By means of the air motor, the piece to be welded can be turned at any desired rate of speed, and the welder does not have to work from beneath or at one side of the piece. The spot to be welded is always beneath his hands and eyes while he remains in a standing position.

Pipe made up of bends and offsets is handled much more easily on the machine than by any other means. The operator can place the piece to be welded in a position where he can use a large electrode with more heat and a minimum possibility of undercut.

The air motor has a gear type reducer, a main valve block on the feeder line, and a speed control, or throttling valve for the use of the operator. The speed control valve is extended on an air hose so that the operator can continue to control the speed of the machine while engaged in welding some distance away.

One of the welders who did a considerable amount of work on the construction of the turntable machine, demonstrated its speed by making two 20-inch butt welds on a spool piece three feet long, with welding both inside and outside, in two hours and 30 minutes; ordinarily a job of this kind takes from 12 to 16 hours. Another six-inch butt weld, of a type that usually required from 25 to 30 minutes, was made on this machine in seven minutes.



A piece of pipe of such shape as to present considerable difficulty under ordinary conditions is handled efficiently by the turntable originated in Ashland Oil & Refining Co.'s welding shop. The operator is shown using the arc in a downhand position with his right hand while controlling the turntable speed with the throttling valve on the air hose in his left hand

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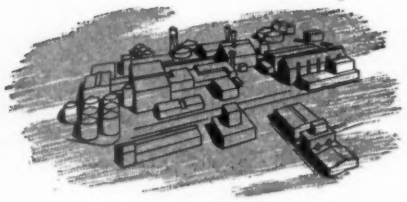

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Gasoline Plant Water Treatment

Case Histories Given of Methods Used for Boiler Feed Water in Plants in Southwest; In Treating Cooling Water, Control of Concentrations of Scale-Forming and Corrosive Materials is Important Factor

The treating of water used for process steam and cooling purposes is important in any gasoline plant but more so in the Southwest, particularly the plains areas of Oklahoma, Kansas and Texas, where supplies often are scanty in quantity and loaded with various objectionable chemicals. Control also is required to prevent the clogging of cooling systems with microbiological slimes, such as algae and various fungus growths.

Very practical information on this subject from the natural gasoline plant operator's standpoint was given by two authorities at the regional meeting sponsored by Natural Gasoline Assn. of America at Amarillo, Texas, Dec. 12. J. C. Hutcheson, Shell Oil Co., Inc., Great Bend, Kans., presented a paper entitled "Gasoline Plant Process Water Treatment," and J. S. Connors, Phillips Petroleum Co., Bartlesville, contributed a lengthy discussion. The two complement and supplement each other so, to eliminate duplications and for brevity, they have been combined in the accompanying article.

THERE are many ways of satisfactorily treating water, the method selected depending to a large extent on the economics of the particular problem. Also, it is a well-known fact that the most common meeting ground for water treating engineers is that they all agree to disagree. Regardless of the means selected, in the last analysis, any reliable method of water treatment will be only as satisfactory as the control of such treatment is accurate, frequent and sufficiently comprehensive.

Most water treating chemists and engineers accept as standards "Betz Handbook of Industrial Water Conditioning"(1), "Boiler Feed and Boiler Water Softening"(2) and "The Data Book"(3). All plant superintendents should have these for ready reference when a specific problem is encountered. Between them, they outline standard methods of water testing, tell how to determine the cause of boiler scale and how to clean heating surfaces, and describe the various methods of water treating for industrial purposes. Unfortunately, most chemistry books do not cover water treatment specifically. Additional recommended references(4,5) are given and more will be found in a search of the extensive literature on this subject.

Often the men in charge of plant water treatment are not chemists. Hence use of chemical terms should be avoided in instructing laymen. Control tests should be set up in such a manner that a layman can understand them, in order to build up his confidence in his ability to carry on the control program.

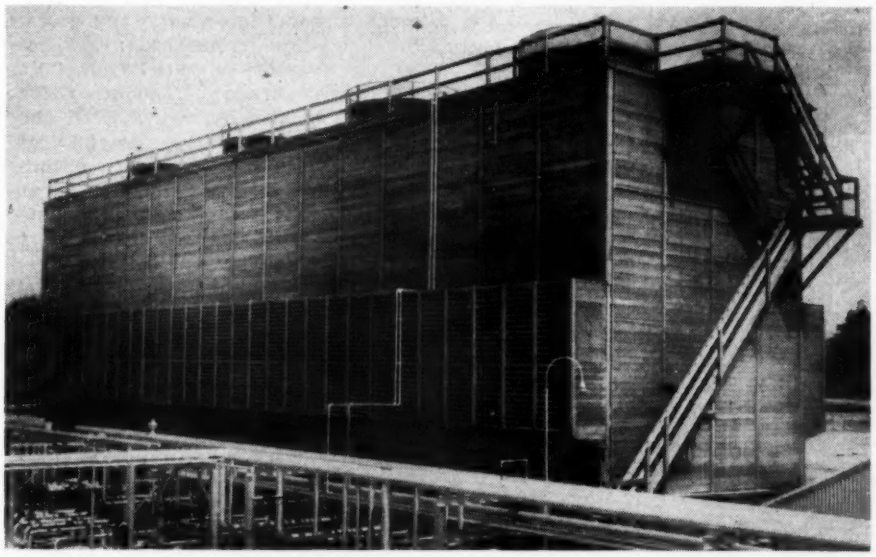
Experience indicates that any man who is not color blind and can add figures can be taught to do a good job in controlling water treatment. However, by going into too much chemistry at first, the layman may be inclined to think the process is too involved for him to handle. Moreover, after some routine testing experience is accumulated, most men become curious; they want to know what is happening and why they are doing certain things. Then is the time to answer their questions fully, making available the standard works mentioned above if they desire to study further.

BOILER WATER TREATMENT

Treating requirements for boiler and cooling water are not necessarily the same, although the same principles of control and methods of analysis apply. In fact, raw untreated water which would not be satisfactory in a boiler often is used as a coolant with desirable results. There are definite advantages to using a softened water as a coolant, however. Therefore the two subjects will be discussed separately, with cooling water treatment following the discussion of boiler water.

General Methods

There are three general methods of boiler water treatment in use, to-



Modern cooling tower installation in natural gasoline plant in the southwest. It must be protected, by adequate water treatment, against delignification and growth of microbiological slime as well as scale deposition

gether with seemingly endless modifications to fit specific cases. A short discussion of the merits and disadvantages of each method follows:

I. Lime-Soda Softening (followed by phosphate and organic after-treatment)

A. Hot Process Deaerating Softeners. Water softened by this method will have a soap hardness of approximately 0.5 to 1.0 grain per gal. with a total alkalinity of 3.5 to 4.5 grain per gal.

1. Advantages: a. Oxygen is practically eliminated. b. Silica content of the water is reduced. c. Alkalinity is lowered, bicarbonates are removed. d. Total solids are reduced. e. Phosphate after-treatment requirements are low. f. Low treating cost. g. Low boiler maintenance and water make-up.
2. Disadvantages: a. High initial investment. b. Moderate flexibility.

B. Cold Process

Water softened by this method will have a soap hardness of approximately 1.0 to 2.0 grain per gal. with a total alkalinity of 4.5 to 5.5 grain per gal.

1. Advantages: a. Silica content is reduced. b. Alkalinity is lowered and some bicarbonates removed. c. Total solids are reduced. d. Low treating cost. e. Low boiler maintenance and make-up.
2. Disadvantages: a. Oxygen is not removed. b. Phosphate after-treatment requirements are relatively high. c. Relatively high initial investment.

II. Zeolite Softening (followed by phosphate and organic after-treatment). Water softened by this method will have a soap hardness of approximately 0 to 0.5 grain per gal.

1. Advantages: a. Relatively low initial investment. b. Low phosphate after-treatment requirement.
2. Disadvantages: a. Oxygen is not removed. b. Silica is not removed and is rendered more liable to deposition within the boiler as a hard glass-like scale. c. Total solids are increased. d. Alkalinity is not lowered and the tendency toward caustic embrittlement is increased. e. Relatively high chemical treating cost. f. Relatively high boiler maintenance and make-up.

III. Internal Softening (with phosphates, soda ash or mixtures of the two, together with organic material.)

1. Advantages: a. Practically no initial investment. b. Extreme flexibility.
2. Disadvantages: a. Oxygen is not removed. b. High chemical cost. c. High make-up requirement. d. Relatively high boiler maintenance.

Straight Zeolite treating is considered impractical for Texas and Oklahoma Panhandle waters, because of high alkalinity and increased total solids. Nevertheless, it may be advantageously combined with other methods.

Several years ago a series of boiler water treatments were set up for Shell's natural gasoline plants in the Tulsa area in accordance with conventional analyses. Recently a survey was made to see that treatment efficiency was being maintained and that plant personnel was fully acquainted with treatment problems. Data included in the report based on the survey, which suggested some remedial operations, is given here.

The Shell company treating methods described represent installations in old plants built before the desirability of careful industrial water conditioning had been demonstrated fully. This equipment is "being made to do" because water treating modernization expense is not now justifiable—a situation to be found in many other plants in the area. Descriptions of methods in Phillips plants, on the other hand, are confined to relatively modern facilities.

I—Lime-Soda Ash Process

In most of the Shell plants, water treatment consists either of lime and soda ash ("Cold Process") or a Zeolite treatment. In the former method water hardness as well as suspended matter is precipitated as a sludge, thereby reducing total solids. Where Zeolite systems are used, the water is further treated with phosphate and tannin in the boilers.

All the boilers have continuous blow-downs and most are using phosphate and tannin as internal treatment to condition sludge and correct for caustic embrittlement. These boilers now are operated from 30 to 160 days without cleanout. Before internal treatment was started they were cleaned regularly every 30 days. Even after 160 days some of these boilers now require very little cleaning out, more time being consumed in cooling off and coming-back to pressure than in cleaning.

In one of the Shell plants inspected, water is furnished from shallow wells to one of two 1600-bbl. steel treating tanks. Following cold treatment with lime and soda for softening a commercial coagulant, "Ferrisul", is used to hasten settling of the fine precipitate formed by the lime-soda ash.

Chemicals are mixed in a slurry with water and transferred to the settling tank by a steam injector. Contents of the tank then are agitated with air until thoroughly mixed, whence the treated water is permitted to settle for a minimum of 8 hours. It is withdrawn from the settler by top draw-off to the engine jacket hot well for circulation through the engine jackets and to the bottom ring of a 55,000-bbl. steel tank. A portion of the treated water is pumped to the boiler feed hot well.

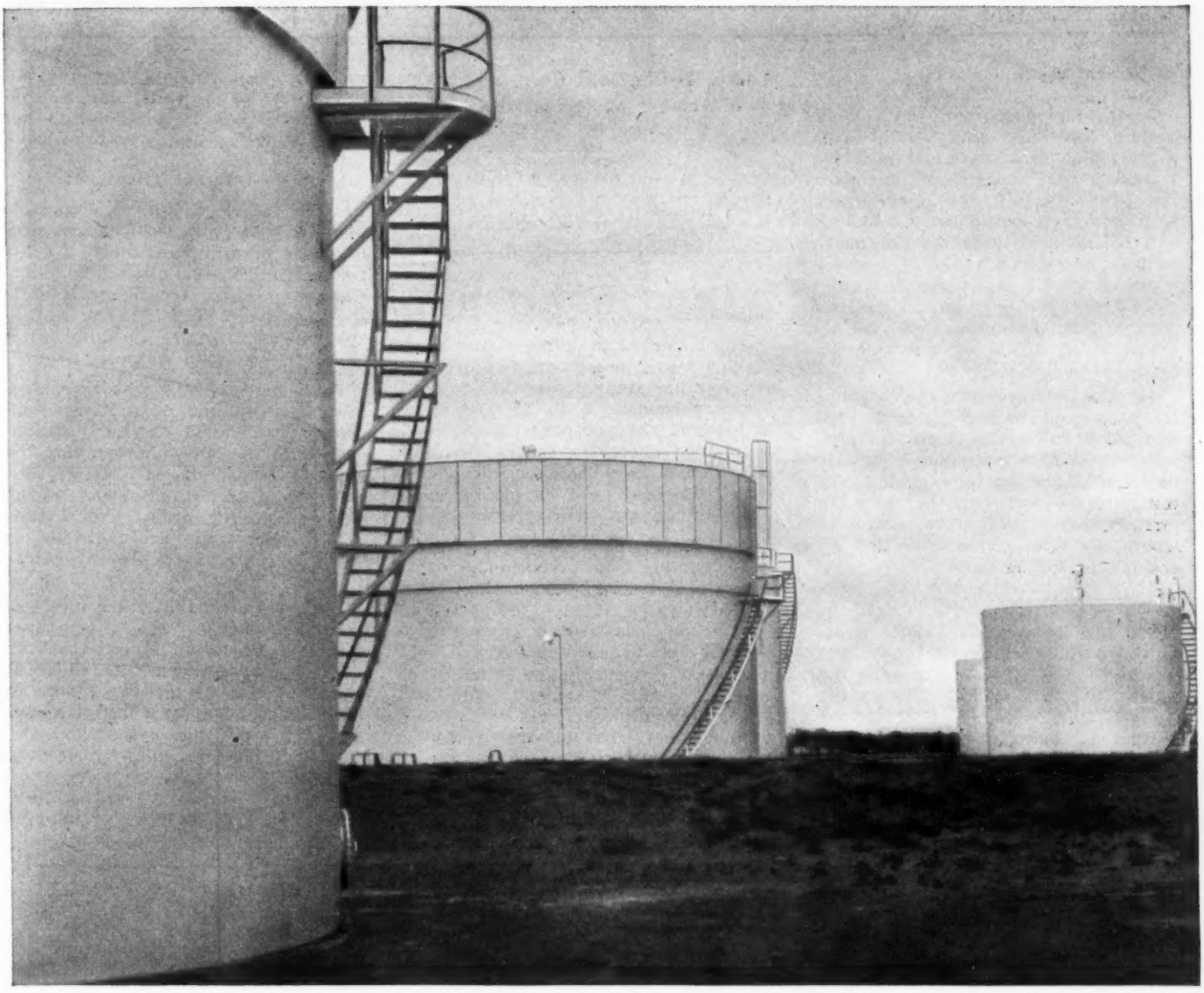
This is not an ideal condition for several reasons. Because this is batch treatment, the treated water is dumped into the system at one time. One of the worst features is the use of an open pit, level with the ground, which permits ready entry to weeds and dirt. Several years ago 18 in. of mud were removed from the pit and 14 in. now have accumulated. Mud cannot be removed from the large tank because of leakage and its reconditioning is not considered feasible. Screening the suction of the circulating pump does not prevent entry of mud into the system, as evidenced by the fact that boilers must be shut down every 30 days to remove mud from the crown-sheets.

In another Shell plant treating results were excellent except for two of the boilers. One had just gone into service after having been stored full of undiluted make-up water for 21 days. The methyl orange (calcium carbonate) alkalinity was 1016 ppm* and the water had been concentrated 17.3 times. This is considered too high, since an attempt is made at all plants to maintain alkalinities at 500 ppm. maximum with methyl orange as indicator, and 250 ppm. to phenolphthalein. One other boiler had only 3.3 cycles of concentration and a methyl orange alkalinity of 280 ppm., which indicated excessive blow-down.

At one of Phillips' Panhandle plants, where the water to be treated has a hardness of 11.8 grain per gal.* and a total alkalinity of 11.4 grain per gal., the chemical treating costs by the hot lime-soda ash process are approximately 9c per 1000 gal. water treated. The softened water has a soap hardness of approximately 1.0 grain per gal., and an alkalinity of only 3.0 grain. The boilers, inspected annually, are found to be free of scale or corrosion. The tubes are mechanically cleaned at this time as a routine.

Boiler feedwater consists of approximately 85% steam condensate and 15% softened water. A mixture of anhydrous disodium phosphate and liquid tannin is injected into the boilers twice each shift to maintain a phosphate residual of 20 to 40 ppm. in the boilers at all times. The eight 145-hp. 148 psi. water tube boilers are heavily fired, requiring total solids to be controlled between 50 and 60 grain per gal.

* 17.1 parts per million = 1 grain per gallon.



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to prevent water entrainment in the steam.

Actual log records for these boiler waters, feedwater, and treated water in this plant are presented in Table 1. Tests are performed by plant operators once daily on boilers, every four hours on softener effluent. It will be noted no data for phosphate radical are given; this is because treating was being controlled from hydroxide (calculated as calcium carbonate) and hardness data, no attempt being made to maintain an excess of phosphate.

In this connection, the Phillips company requires each plant to send monthly a full set of water samples, taken at random on a single day, to its main laboratory for checking. The results are reported to the plant superintendent who, in turn, compares laboratory findings against the operator's log for the date.

II—Zeolite Treating

Two Shell plants use Zeolite treated water followed by phosphate and tannin in the boilers. In one the boiler water was satisfactory except for one unit which had a stopped continuous blow-down line. Phosphate was somewhat low, ranging from 5 to 20 ppm., where it should have been 35 to 60 ppm. Chloride concentrations were being maintained at 4 to 5, necessitated by the high total solids.

The boilers at the other plant using Zeolite initial treatment had a methyl orange alkalinity of 512 to 790 ppm.; phosphate 5 to 15 ppm. It is believed the phosphate is too low but, since operators report running 160 to 190 days between cleanouts with little scale and no pitting evident, no changes were recommended.

A Phillips plant Zeolite softens water coming from a continuous cold lime-alum treater, deaerating the softened water at high temperature for carbon dioxide and oxygen removal. The boilers are fed a 50-50 mixture of condensate and soft water, have a normal on-stream time of one year, and are found scale-free on inspection. The abnormally high boiler make-up requirements here are due to a large process steam requirement, from which condensate cannot be recovered. Even with the high make-up requirements, however, alkalinity of boiler water can be controlled between 29 to 35 grain per gal. without excessive blowdown.

III—Internal Treatment

At another Phillips Panhandle plant the make-up water has a soap hardness of approximately 8.0 grain per gal., with alkalinity of 10 grain. Chemical costs are approximately 13c per 1000 gal. Boilers are inspected and require cleaning after 22 to 26 weeks in service.

Total boiler feed consists of 33% raw make-up and 67% return condensate. Chemical is fed continuously into the hot-well supplying the eight 145-hp. 148-psi. water tube boiler, fired at 138%of rating (seven normally on the line). Total solids in the boiler water are controlled at 80 to 100 grains to prevent carryover.

Table 2 shows the water analyses from this plant. Table 3 compares the plant of Table 1 with that of Table 2 and presents the chemical treatment cost of the two plants in terms of cost per 1000 lbs. of steam produced. In this connection, the plant of Table 2 sends approximately 35,000 gal. per day of steam condensate to the cooling tower because it contains some 43 ppm. of mineral

TABLE 3—Chemical Cost per 1,000 Lbs. of Steam Produced

	Steam Produced Lbs./Day	Chemical Cost $/Day	Chemical Cost Per 1,000 lbs. Steam
Hot lime-soda softened makeup	1,980,000	2.70	$0.00136
Internally treated	1,140,000	6.50	0.0057

TABLE 1—Results Obtained by Hot-Treating with Lime-Soda Ash

Analysis, Grains per Gallon*

Sample	Dissolved Solids	NaCl	Soap Hardness	Alkalinity Phenolphthalein	Alkalinity Methyl Orange	Alkalinity Hydroxide (as $Ca CO_3$)	Total Sodium Alkalinity (as $Ca CO_3$)	Excess $Na_2 CO_3$ (as $Ca CO_3$)
Treated Water	..	1.2	0.9	1.1	2.8	0.6	1.9	1.3
Boiler Feed	..	0.2	0.3	0.0	0.9	0.0	0.6	0.0
Boiler No. 1	49	8.2	0	13.8	15.7	11.9	15.7	3.8
Boiler No. 2	49	7.6	0	13.0	16.1	9.9	16.1	6.2
Boiler No. 3	68	11.1	0	18.5	21.5	15.5	21.5	6.0
Boiler No. 4	67	10.5	0	17.5	20.6	14.4	20.6	6.2
Boiler No. 5	52	9.2	0	14.7	17.7	11.7	17.7	6.0
Boiler No. 6	56	9.7	0	16.6	19.1	12.9	19.1	6.2
Boiler No. 7	49	5.7	0	13.0	15.8	10.2	15.8	5.6
Boiler No. 8	34	5.0	0	9.2	11.2	7.2	11.2	4.0

Water treated, gal./day	30,372	Daily chemical consumption, lbs.	
Steam produced, lbs./hr.	84,000	Hydrated lime	54
Rated Btu hp. operating	1,160	Soda ash	14.4
Boiler efficiency, %	214	Disodium phosphate	12.0
		Liquid tannin	3.0

* Phosphates not determined. To convert gr./gal. to ppm. multiply by 17.1.

TABLE 2—Results Obtained With Internal Treating of Boiler Water

Analysis, Grains per Gallon*

Sample	Dissolved Solids	NaCl	Soap Hardness	Alkalinity Phenolphthalein	Alkalinity Methyl Orange	Alkalinity Hydroxide (as Ca CO)	Total Sodium Alkalinity (as Ca CO)	Excess $Na_2 CO_3$ (as Ca CO)
Raw Water	2.0	2.0	8.4	0.0	10.0	0.0	1.6	..
Boiler Feed	0.5	0.5	1.0	1.0	2.8	0.0	0.8	..
Boiler No. 1	75	18.2	0	39.9	43.4	36.4	43.4	7.0
Boiler No. 2	75	19.0	0	40.1	44.2	36.0	44.2	8.2
Boiler No. 3	80	25.0	0	43.9	47.5	40.3	43.9	7.2
Boiler No. 4	63	20.9	0	33.3	37.3	29.3	33.3	6.0
Boiler No. 5	110	33.0	0	59.3	65.3	53.3	65.3	12.0
Boiler No. 6	43	9.2	0	22.5	25.6	19.4	25.6	6.2
**Boiler No. 7	20	5.0	0	11.2	12.4	10.1	12.4	2.4
Boiler No. 8	100	25.0	0	52.8	59.0	46.6	59.0	12.4

Water treated (make-up), gal./day	50,000	Daily chemical consumption, lbs.	
Steam produced, lbs./hr.	47,500	Btu compound No. 3100	36
***Rated Btu hp. operating	1,015	Antifoam No. 78	4.5
***Boiler efficiency, %	138	Liquid tannin	4.5

* Phosphates not determined—To convert gr./gal. to ppm. multiply by 17.1.
** Just coming on line.
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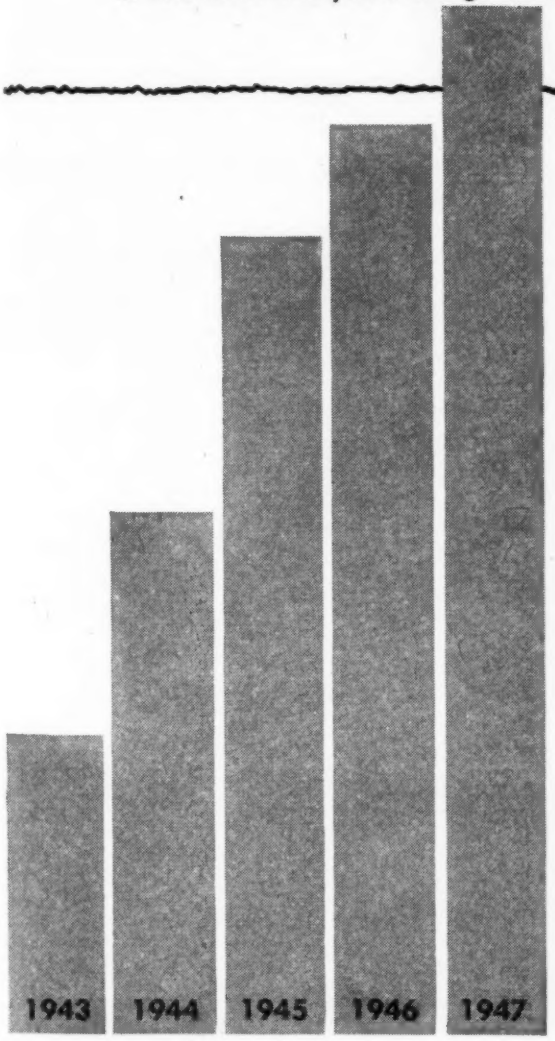

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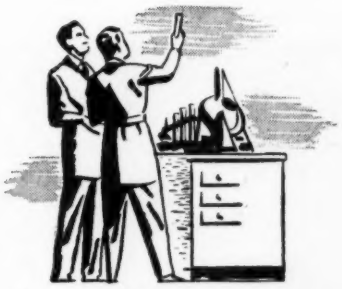

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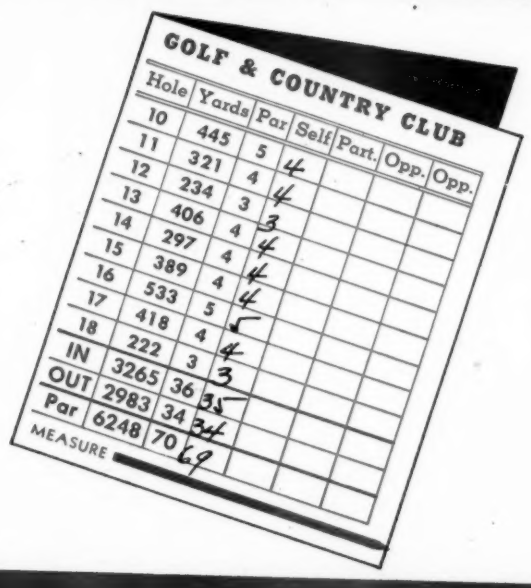

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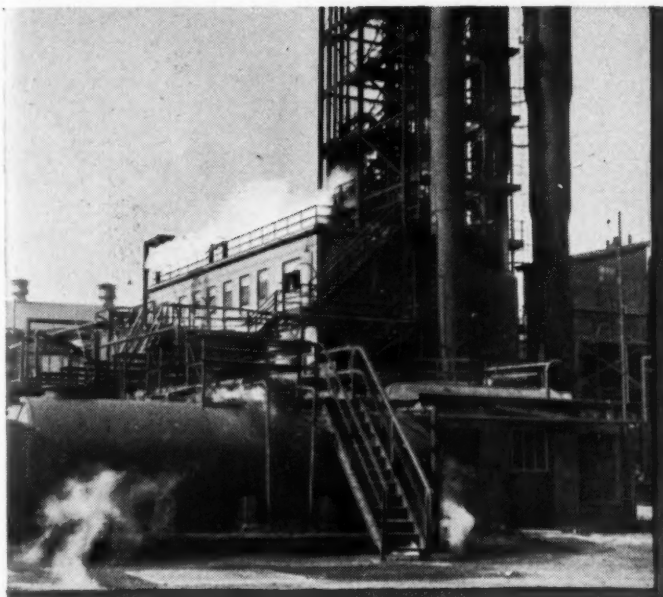

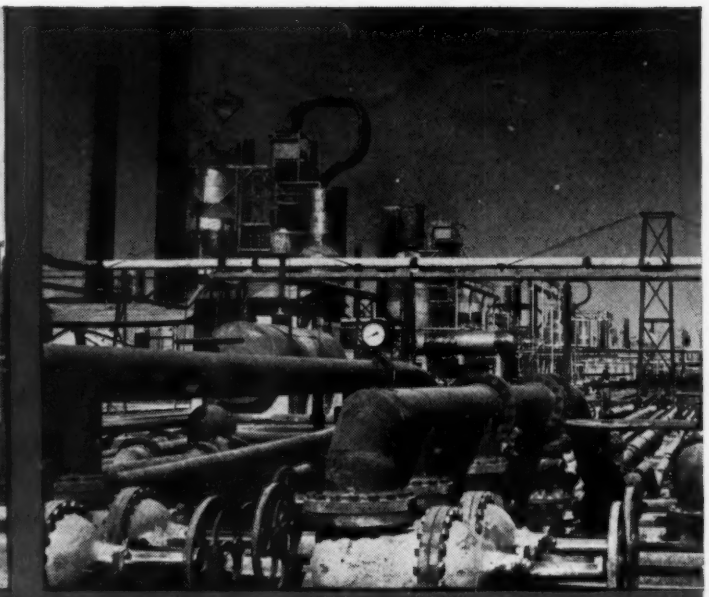

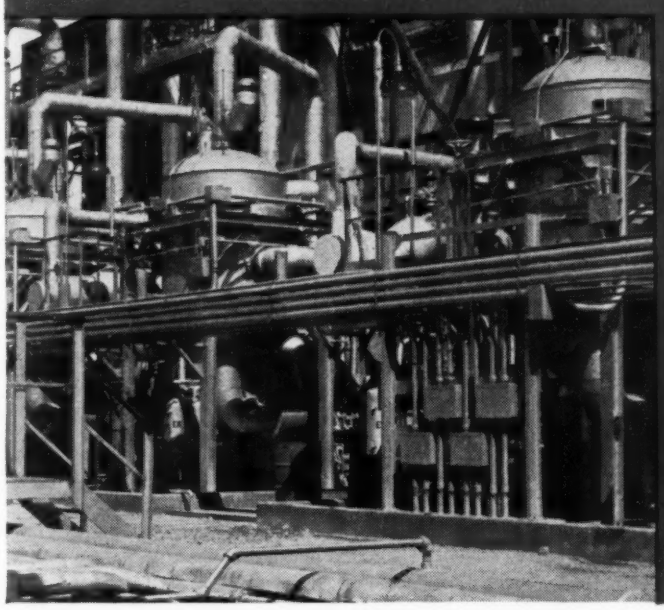

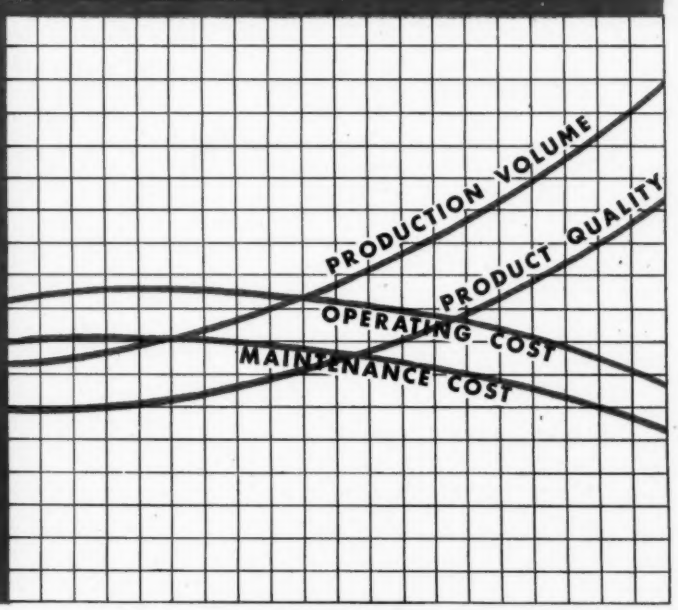

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seal oil. If this contaminated condensate was returned to an internally treated boiler, the boiler sludge would tend to bake on the tubes as a semi-scale and predispose them toward failure.

At another Shell plant no treatment is used except internal treatment for the boilers. Tests on the first day indicated that the methyl orange and phenolphthalein alkalinities of these boilers were extremely high while phosphate was 25 to 45 ppm. Two days of excessive bottom blow-down reduced the alkalinities appreciably but insufficiently and instructions were left to continue blow-down until methyl orange alkalinities were reduced to the standard 500 ppm. for each boiler.

At another Shell plant untreated lake water is fed to the boilers, which are internally treated with soda ash and sodium aluminate. Methyl orange alkalinity in the boilers was 436 to 1028 ppm., and phenolphthalein alkalinity was from 352 to 808 ppm. By excessive bottom blow-down, methyl orange alkalinity was reduced in boiler No. 1 from 1028 to 836 ppm.

Alkalinity in boilers 2 and 3 increased during this time, probably from the large amount of insufficiently-treated raw water added to the system to compensate for the excessive blow-downs. All three then were blown-down until methyl orange alkalinities ranged from 152 to 220 ppm. This was too low and operators were ordered to permit methyl orange alkalinities to reach 500 ppm.

COOLING TOWER OPERATION

When softened water is used as make-up for cooling tower operation it must be remembered, first, that Zeolite-softened water is normally corrosive, has a high alkalinity and that after concentrating and heating the excessive quantity of sodium carbonate present will cause rapid delignification of the cooling tower.

Second, while total solids have been reduced, in cold lime-soda softening the water is stable and any increase in temperature will cause additional precipitation of hardness due to shifting of chemical equilibria. This usually is offset by recarbonation with either sulfuric acid or carbon dioxide. But, a water which has been softened and recarbonated is *always* corrosive and careful control of the concentrations is necessary to return the system to equilibrium.

Calcium carbonate in recarbonated water may be held in solution either by chemical or mechanical means. Use of sulfuric acid will convert the carbonate to the more stable and soluble calcium sulfate and is relatively low cost treatment. At the temperatures normally encountered in cooling water, 1200 to 1600 ppm. of $CaSO_4$ can safely be carried without serious precipitation. This also permits an increase in the safe maximum concentration of total solids. $CaCO_3$ concentrations may be controlled mechanically by continuous blow-down of the cooling system to compensate for concentration through evaporation, windage losses and the like. Solubilities of $CaCO_3$ in water are low, approximately 92 ppm. at 32° F., 15 ppm. at 212° F. and 10 ppm. at 356° F.

Table 4 gives a comparison between untreated and treated cooling water[1]. It will be noted that with 50 ppm. of calcium present in the raw water and three cycles of concentration, the circulation water should have contained 150 ppm. if none had precipitated to form scale or sludge. Actually 65 ppm. of calcium is present, which means 85 ppm. has precipitated as scale. With the acid-treated water the methyl orange alkalinity has been limited to 250 ppm., whereas the sulfate content of the water has been sharply increased to 1265 ppm. With 50 ppm. of calcium in the raw water, 350 ppm. would be expected in the water having 7 concentrations. Actually, it was found that 340 ppm. of calcium was present, which represents 97% maintained in a soluble form.

One big advantage of the acid treated water, therefore, was the retention of scale-forming material in solution. An equally important point, however, is that 50 gal. per minute, or 22%, less make-up water was required due to the reduction in blow-down losses made possible by carrying higher concentrations of total solids without deposition on heat-transfer surfaces. In many gasoline plants where water is a scarce material, this factor assumes major proportions.

Stability Predictions

Several methods have been proposed by which the tendency of the water to either dissolve or precipitate calcium carbonate may be predicted.

W. F. Langlier proposed that the tendency of the water to form scale or to corrode could be calculated by the formula: pH — pHs = Saturation Index, whereby a positive number indicates scale formation and a negative one, corrosion. The greater

TABLE 4 — Comparison Between Untreated and Treated Cooling Water (Betz)

(Parts per million)

	Raw	Un-treated	Acid-treated
Total Hardness as $CaCO_3$	75	135	510
Sulphate as SO_4	20	60	1265
Alkalinity to Methyl Orange as $CaCO_3$	200	600	250
Calcium as $CaCO_3$	50	65	340
Magnesium as $CaCO_3$	25	65	170
Blowdown, gpm		57	7
Makeup, gpm		225	175
Cycles of Concentrations		3	7

the value the greater the tendency.

T. E. Larson and A. M. Buswell modified Langlier's method and the latter is accepted as standard for want of a better. Tables for determining "pHs" of any water are available. Still later Dr. John Ryznar proposed that, for recirculated waters, the Langlier index should be modified so that the tendency to scale or corrode could be calculated by the formula: 2pHs − pH = Stability Index. In this, all values are positive. Values above 7.0 indicate a corrosive tendency while those below 6.5 denote an increasing tendency toward scale formation.

As an example of these methods of calculation, a Panhandle water which has been lime-soda softened and recarbonated with sulfuric acid might have the following significant composition:

Component	Gr./Gal.
Dissolved solids	8.2
Total soap hardness	0.9
Calcium hardness	0.2
NaCl	1.2
Na_2SO_4	2.0
Total alkalinity	2.0
pH	7.2
pHs	9.5
Langlier Index (pH-pHs) =	− 2.3*
Ryznar Index (2pHs-pH) =	11.8*

*Corrosive

Now assume this water is concentrated 8 times. The composition will be:

Composition	Gr./Gal.
Dissolved solids	65.6
Soap hardness	7.2
Calcium hardness	1.6
NaCl	9.6
Na_2SO_4	16.0
Total alkalinity	16.0
Predicted pH	9.3
pHs	7.7
Langlier Index (pH-pHs) =	1.6*
Ryznar Index (2pHs-pH) =	6.1**

*Scale forming.

**Very slightly scale forming.

It is obvious that in either of the above cases only a very small amount of calcium is available for scale formation.

Raw Water Make-Up

Where raw water is used as cooling tower make-up and treated with sulfuric acid to control the alkalinity of the water in the tower pits, similar calculations can be made to show the tendency for the concentrated water to be either scale forming or corrosive. The objection to this method of treating is the excessively close control of both alkalinities and concentrations required.

Algae Control

Growth of algae and related slimes is ordinarily controlled by copper sulfate, chlorine and various proprietary algecides, most of which contain copper organic compounds, potassium permanganate and sodium pentachlorphenate (Santobrite). No matter which algecide is used, the microbiological slimes will slowly build up an immunity—much as the human body can develop a tolerance for ordinarily lethal quantities of arsenic—thus making it necessary to vary the type used from time to time. Copper sulfate is one of the cheapest materials available and most frequently used. When immunity to this material develops a switch to one of the others is made until such time as copper sulfate again becomes effective.

Treatment with algecide in large quantities—20-40 ppm at a time—is preferable to smaller, continuous dosages. It should be started before very much algae are present, or the treatment may kill enough to result in detachment of large quantities of the growth, which may clog some of the water passages, causing extensive shutdowns and expensive cleanout jobs. If large amounts of growth are known to be present, small quantities of chemical should be used initially so that all algae will not be killed at one time, followed by gradually increasing dosages until all growth is destroyed. Copper sulfate is at its best advantage when the pH of the water is approximately 7.0 *before* addition of chemical.

Corrosion Inhibitors

The use of corrosion inhibitors in plant water is becoming more general. Corrosive but non-scale forming water may be inhibited successfully against corrosion by the use of organic chromium compounds or the sodium chromates. The organic salts are more effective than the inorganic compounds. Control of pH is important, a value of 8.5 to 9 being necessary for good protection where sodium chromate is used, while the organic chromates can be used at a much lower figure.

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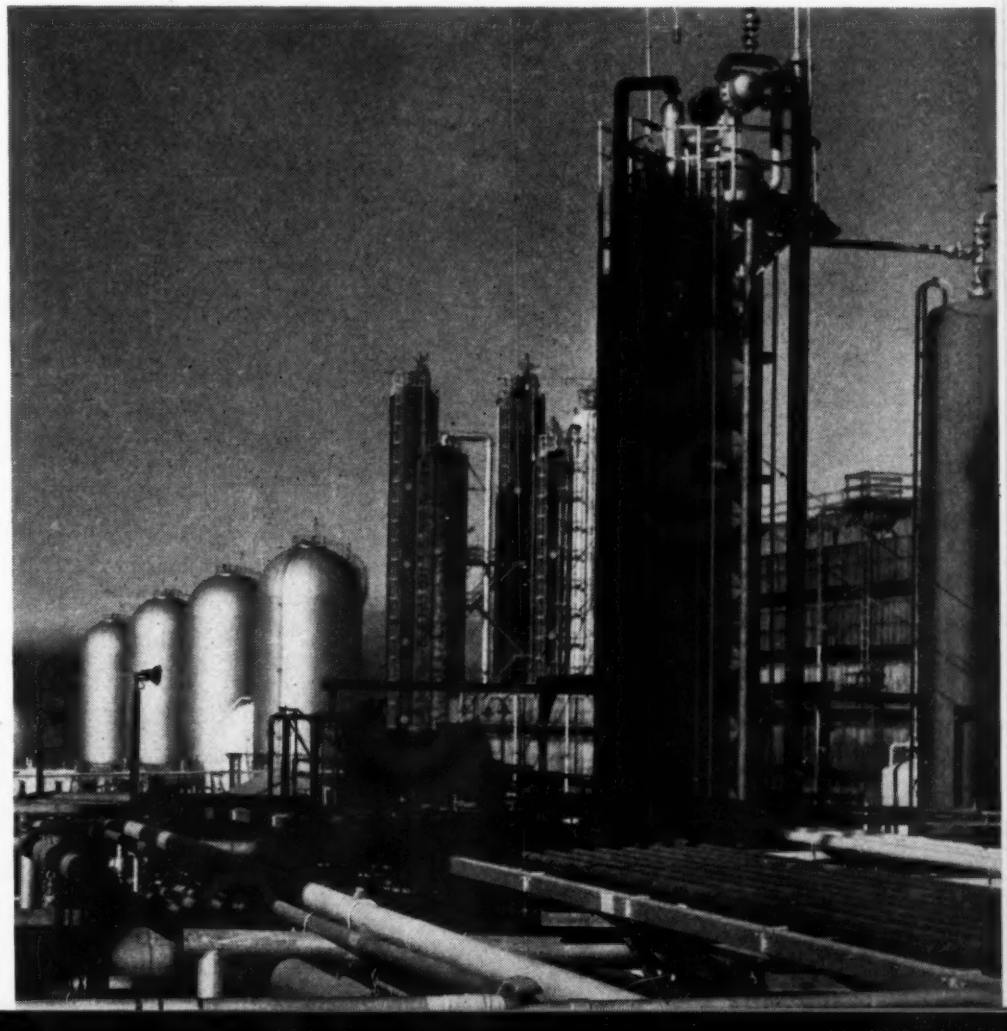
Portion of distillation and storage section of gasoline plant of Phillips Petroleum Co. at Borger, Texas. Cooling tower is in background at the right



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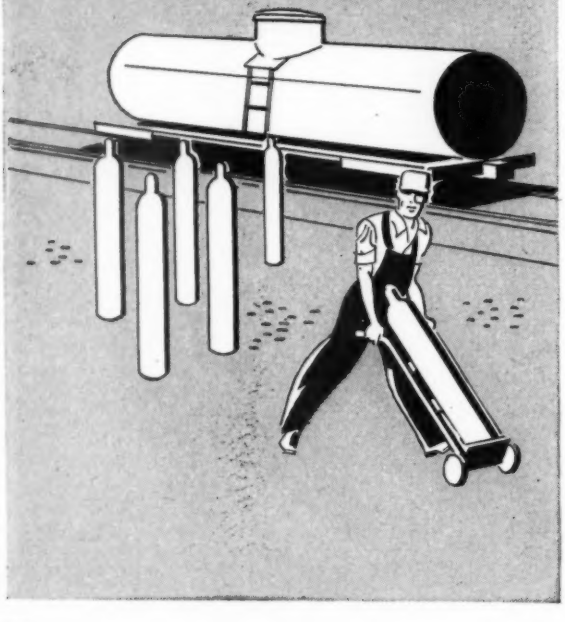

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Characteristics and Related Toxicity of Hydrocarbon Oils

By J. A. VAUGHAN

Research Engineer, Southern Wood Preserving Co., Atlanta, Ga.

Specially reformed petroleum fractions, among other hydrocarbon oils, were studied to determine causes underlying the toxicity of the coal-tar distillates known as "creosotes" for wood preservatives. Aromatic content and specific gravity-boiling point relationship were found to be factors controlling toxicity. It was determined that the presence of aromatic hydrocarbons and an established specific gravity-boiling point relationship provides a means of predicting toxicity toward fungi. Petroleum aromatic mixtures containing olefins and saturates, when processed to establish a relatively high specific gravity in relation to boiling range were found to have high toxicity values.

THE distillate of high-temperature coal tar has been used for more than 100 years in wood preservation. However, prior to the advent of research which was begun about 10 years ago[1], the literature seems to contain little information concerning the real reasons underlying the toxicity of coal-tar creosote toward wood-destroying fungi. Bateman[2] and several others had made a few preliminary studies in the past, in order to develop a theory on the mechanism of the protection of wood by preservatives.

Over the years, the term "creosote" has come to mean that portion of the distillate of high-temperature coal tar falling within a certain approximate range of boiling points and commonly used for preserving wood[3]. In the beginning it was gradually found from actual experience that creosote was a good wood preservative and, without the necessity or benefit of any exhaustive study of its physical and chemical characteristics, it was accepted as such.

Reasons for Toxicity Vague

With the development of laboratory test methods for determining the toxicity of various materials which may be used as wood preservatives[4], and with the accumulation of test-plot and service data, the wood-preserving industry has demonstrated that the distillate of high-temperature coal tar is not only toxic to wood-destroying organisms, but also possesses other required wood-preserving qualities. In spite of this, however, the reasons underlying the toxic value of coal-tar creosote have been somewhat vague.

Due to the use of different coals, or more particularly to the methods of coking or otherwise processing the coals to produce tar, a wide range of physical and chemical characteristics, as well as a broad range of distillation characteristics, have been demonstrated by the creosotes produced from the various tars. Another factor causing variations in the distillation characteristics is the fluctuating or changing market in by-products, which in turn controls the point to which the distillation is carried in order that the residuum may be soft pitch, hard pitch, or pitch coke. It would appear from toxicity tests, however, that regardless of the variation in distillation pattern of various high-temperature coal-tar distillates, all of them evidence reasonably satisfactory toxicity.

Therefore, the specifications covering creosote oil, as originally written and as they appear today, are very broad so as to admit any natural run distillate of high-temperature coal tar. Specifications, however, depend primarily upon that phrase, which appears in all of them, requiring that the source of the creosote be high-temperature coal tar or coke oven tar[5]. In other words, knowing that high-temperature coal-tar distillates were toxic to wood-destroying fungi, but not knowing the reasons underlying their toxicity, the specifications were designed to fit the product.

In the early thirties, a long range project was established in the Research Department of the Southern Wood Preserving Co., for the purpose of investigating various hydrocarbon oils as wood preservatives and of establishing, if possible, the reasons for toxicity or lack of toxicity in these oils. In the initial stages of the work, starting materials were limited to high-temperature coal-tar distillates, several water-gas-tar distillates of different physical characteristics, and a few highly aromatic petroleum distillates and residuums. A study of the physical and chemical characteristics of individual fractions of these initial samples and subsequent toxicity tests indicated a general relationship between the toxicity and the specific gravity—boiling point relationship of the fractions.

Other Samples Needed

It was immediately realized, however, that it would be necessary to obtain other samples exhibiting a wider range of physical and chemical characteristics, in order definitely to determine whether there was a relationship between these characteristics of the fractions and their toxicity. The next step, therefore, was to develop some laboratory method of processing the various samples to a point where they would exhibit different chemical and physical characteristics. This proposed work posed the problem of just what it was desirable to accomplish in the processing to give various types of oils for further experiment and study.

Early in the studies it had become apparent that the presence of aromatic hydrocarbons alone might account for toxicity in hydrocarbon oils. Since the boiling point of aromatic hydrocarbons tends to increase as hydrocarbon chains are added or lengthened (i.e., carbon atoms are increased in the chains) and since the specific gravity of the aromatics tends to decrease in relation to the boiling point as chains are added or lengthened (Table 1), it was evident that, if the processing of the starting material could be properly controlled, it would result in finished products, depending on the control, having varying specific gravity-boiling point relationships for the various fractions.

It was found that processing high-

TABLE 1—Boiling Point-Specific Gravity Relation of Aromatic Hydrocarbons

Name	Formula	Carbons in Chains	B.P. °C	Sp. Gr.	B. P./Sp. Gr. Factor*
Benzene Series					
Benzene	C_6H_6	..	80.1	0.879	91.0
Toluene	$C_6H_5CH_3$	1	110.8	0.866	127.9
Ethyl Benzene	$C_6H_5C_2H_5$	2	136.2	0.867	157.1
Ortho-dimethylbenzene	$C_6H_4(CH_3)_2$	2	144.0	0.881	163.5
Propyl Benzene (n)	$C_6H_5CH(CH_3)_2$	3	159.5	0.862	185.1
Trimethyl Benzene (1,2,3)	$C_6H_3(CH_3)_3$	3	176.1	0.894	195.8
Diethyl Benzene (o)	$C_6H_4(C_2H_5)_2$	4	176.5	0.881	200.3
Tetramethyl Benzene (1,2,4,5)	$C_6H_2(CH_3)_4$	4	175.0	0.872	200.7
Butyl Benzene (n)	$C_6H_5C_4H_9$	4	183.1	0.862	212.3
Diethyl Toluene (3,5)	$(C_2H_5)_2C_6H_3CH_3$	5	199.0	0.879	226.4
Triethyl Benzene (1,3,5)	$C_6H_3(C_2H_5)_3$	6	215.0	0.861	249.7
Diphenyl	$C_6H_5C_6H_5$	6	254.9	0.992	256.9
Naphthalene Series					
Naphthalene	$C_{10}H_8$	..	218.0	1.152	189.20
Methyl Naphthalene (b)	$C_{10}H_7CH_3$	1	241.5	1.001	240.30
Ethyl Naphthalene (b)	$C_{10}H_7C_2H_5$	2	251.0	1.008	249.00
Dimethyl Naphthalene (1,4)	$C_{10}H_6(CH_3)_2$	2	265.0	1.016	260.80

* Factor determined by dividing B. P. °C by Sp. Gr. and taken as the boiling point-specific gravity relation.

temperature coal-tar distillates resulted in very little change in the specific gravity-boiling point relationship of the fractions. On the other hand, changes in water-gas-tar distillates could be accomplished through processing, with the more marked changes occurring in those samples showing the lower specific gravity with relation to boiling points. This was to be expected, since the processing was primarily designed to shorten the side-chain structure of the aromatics. In using the highly aromatic petroleums which exhibited little or no toxicity (within the limits of acceptable values) it was possible, by controlling the process, to produce oils showing a very wide range of gravity-boiling point relationship.

High-temperature coal-tar creosote is a hydrocarbon oil containing a high percentage of aromatic compounds, some olefins and saturates, varying percentages of tar acids and bases, and percentages of a number of various compounds of complex chemical nature. Although it has been shown that many of the identified components of coal-tar creosote have toxic properties, as for example the tar acids, it has been shown that high-temperature coal-tar creosote, from which the tar acids have been removed, will continue to possess toxic properties[6].

Further, it has been shown that certain water-gas-tar creosotes have toxic properties equivalent to the best coal-tar creosotes, while other water-gas-tar creosotes show little toxicity toward wood-destroying fungi. In water-gas-tar, the nitrogenous bases and phenols are absent or nearly so[7]. On the other hand, the percentage of aromatics in water-gas-tar creosote may be as high as in coal-tar creosote.

Many petroleum distillates and residuals, particularly those derived from thermal or catalytic cracking processes, may be highly aromatic and yet show little if any toxic properties toward wood-destroying fungi.

Considering the above facts, it seemed certain that aromatic hydrocarbon compounds alone might be responsible for toxicity. However, since all aromatic hydrocarbon mixtures do not show this characteristic, and since some show it in widely varying degrees, it appeared that the character of the aromatic itself might be the determining factor. It was concluded, therefore, that aromatic hydrocarbons having certain chemical and physical properties would be toxic to wood-destrying organisms, and that hydrocarbon oils containing sufficient quantities of these aromatic compounds would also be toxic.

Proceeding along this line of thought, many laboratory process runs were made, in order to produce varying samples for study and also to develop the process and controls which would result in the production of hydrocarbon oils having those physical and chemical characteristics which the toxicity tests indicated were required of a satisfactory creosote wood preservative.

Use ASTM Standard

For convenience in making direct comparisons of the materials under study, as against coal-tar creosote, it was decided to employ the ASTM Standard D246-42 (AWPA Standard 11g) fractional cuts rather than to attempt to continue the use of the narrow boiling ranges or separated aromatics. The work which followed has shown this to be a satisfactory procedure and has made possible the setting up of a rather simple method of analysis. This is of great advantage in that wood preservatives are subject to frequent field inspections to determine their value.

Since the studies were to involve a determination of the aromatic content of the samples, a new method developed at the Central Experiment Station, U. S. Bureau of Mines, Pittsburgh[8], was employed to give a sufficiently accurate determination of olefins, aromatics, and saturates.

As the analyses were made of the samples, prepared through the developed process controls, and as the toxic values of these samples were determined and studied, it became more and more apparent that aromatic content and specific gravity-boiling point relation of the fractions under study were definite factors connected with the toxicity of hydrocarbon oils. Specific gravity-boiling point relations of the fractions were plotted against their determined toxicities and gradually curves were evolved from which very definite process controls could be determined for producing a product having acceptable toxicity as a wood preservative. The controls establishing toxicity were those governing the specific gravity of the fractions and the percentage of aromatics in the fractions, as well as in the whole oil, and were as follows:

Fractions	Specific Gravity (ASTM D369-33)
0°-210° C.	Minimum 0.85
210°-235° C.	Minimum 0.90
235°-270° C.	Minimum 0.95
270°-315° C.	Minimum 1.00
315°-355° C.	Minimum 1.05

Fractions	Aromatics
0°-210° C.	Minimum 75% Preferred 80%
210°-235° C.	Minimum 75% Preferred 85%
235°-270° C.	Minimum 75% Preferred 90%
270°-315° C.	Minimum 75% Preferred 90%
315°-355° C.	Minimum 75% Preferred 90%

When petroleum hydrocarbons were processed so as to obtain the required specific gravity of the fractions, it was found, more often than not, that the percentage of aromatics in the fractions exceeded the minimums listed above, and usually met the preferred percentages.

In a further attempt to prove that the toxicity of aromatic hydrocarbon mixtures is related to aromatic structure, petroleum aromatic mixtures containing olefins and saturates were selected from those materials having relatively low specific gravity in comparison to their boiling range. The fractional parts, as well as a whole sample of these materials, were tested for toxic value by the agar-flask method[9] at the Forest Products Laboratory in Madison, Wis. These materials were found to show potential toxicity, but only to the extent that more than 10% of the whole sample was required to produce total inhibition; of the fractional parts, the normal growth of fungus at 5% ranged from one to 23%. The same samples, when processed to establish a relatively higher specific gravity for each specified boiling range, showed that only about 0.10% was required to produce total inhibition to the growth of fungus; of the fractional parts, the quantity required to produce total inhibition ranged from 0.006 to 0.02%. These latter values are equivalent to those of the corresponding fractions of coal-tar creosote.

A continued study of aromatic hydrocarbon mixtures obtained from coal tars, water-gas tars, and petroleum residuals (processed and unproc-

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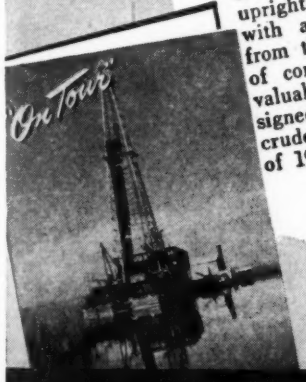

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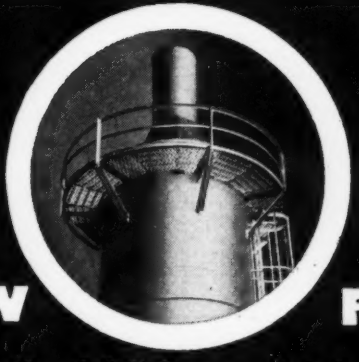

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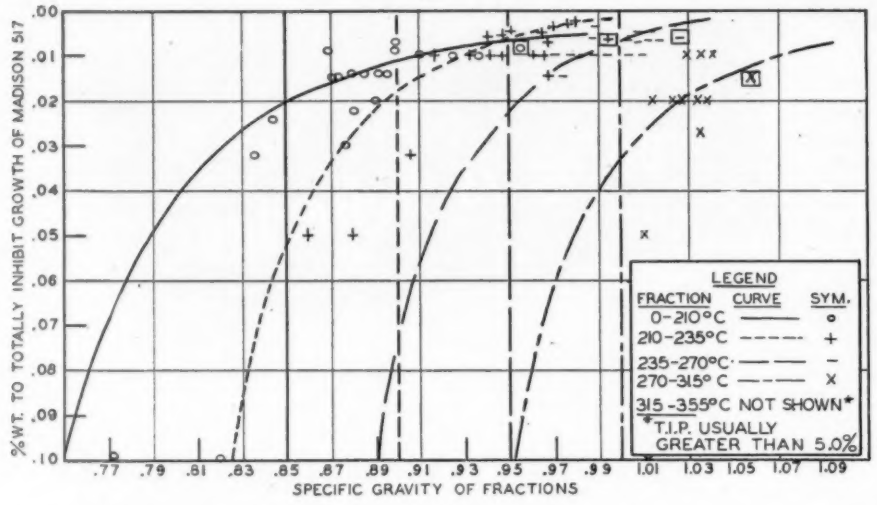

Fig. 1—Preliminary toxicity curves for hydrocarbon oils containing not less than 75% aromatics. The vertical lines represent safe minimum specific gravities in each case. (Note: Symbols enclosed by □ denote coal-tar creosote.)

essed), as well as of some pure aromatic compounds, indicated that toxicity of these materials, as determined by the agar-flask method, is definitely related to the boiling point-specific gravity relation of the materials. It also indicated that the boiling point-specific gravity relation is a function of the carbon atoms in the side chains attached to the ring structure.

In the case of those aromatic derivatives containing oxygen, nitrogen, sulphur, or hydroxy radicals, the boiling point-specific gravity relation may also be a function of the atom or radical attached to the ring structure. This is well illustrated by comparing phenol (C_6H_5OH—BP 181.4° C.—Sp. Gr. 1.071—Factor 169.3) and m-dihydroxy benzene, ($C_6H_4(OH)_2$—BP 276.5° C.—Sp. Gr. 1.272—Factor 217.4).

It does not appear, however, that the presence of oxygen, nitrogen, sulphur, or the hydroxy radical in the aromatic structure is necessary to give toxicity toward wood-destroying organisms. It has been shown, moreover, that the effect of an individual group on the toxicity of an aromatic may be to increase toxicity or to have a marked depressant effect on toxicity[9]. In any event, the presence of such groups in coal-tar distillates will account for the higher specific gravity within a stated boiling range than will be found in the same boiling range of a petroleum creosote (Table 2). This results from the fact that the petroleum creosote is composed almost entirely of aromatics containing only carbon and hydrogen. Reference to the curves shown in Fig. 1 will show that in the same boiling range the fractions from coal-tar creosote exhibit the higher specific gravity, but that many of the lower density petroleum creosote fractions show greater toxic value in the same boiling range.

It has been pointed out that hydrocarbon oils containing a minimum of 75% aromatics and having certain minimum specific gravity within a given boiling range will exhibit satisfactory preservative value as indicated by the agar-flask method employing fungus Madison 517. Based on studies and results secured from several hundred samples, prepared in accordance with the proper process controls, it appears that the percent of sample by weight, which will totally inhibit the growth of Madison 517 when employing the agar-flask method, will be usually not more than the indicated values for each fraction and specific gravity of that fraction as given in Table 3.

Toxic values such as these are extremely satisfactory for hydrocarbon oils to be used as wood preservatives, provided, of course, that the permanency of toxicity is satisfactory. That, however, is not a part of the discussion at the moment.

This report is of a preliminary nature only, and makes no attempt to cover the full field of the studies. When the accumulated data is fully analyzed and correlated, a more revealing report will be presented.

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TABLE 2—Organic Ring System Derivatives Which Affect Boiling Point-Specific Gravity Relationship of Hydrocarbon Oils

(Some or All of These May Be Found in Coal Tar)

Name	Formula	Carbons in Chains	B.P. °C	Sp. Gr.	B. P./Sp. Gr. Factor*
Thiophene	C_4H_4S	..	84.1	1.070	78.5
Pyridene	C_5H_5N	..	115.0	0.978	117.6
Pyrrole	C_4H_4NH	..	133.0	1.077	123.5
a—Picoline	$C_5H_4NC(CH_3)$	2	128.8	0.950	135.6
Thiophenol	C_6H_5SH	..	168.5	1.074	156.9
Coumarone	C_8H_6O	..	173.5	1.078	160.9
Phenol	C_6H_5OH	..	181.4	1.071	169.3
Dihydroxy Benzene (o)	$C_6H_4(OH)_2$	..	242.5	1.344	180.4
Cresol (o)	$C_6H_4(CH_3)OH$	1	191.0	1.052	181.6
Cresol (p)	$C_6H_4(CH_3)OH$	1	202.0	1.039	194.4
Cresol (m)	$C_6H_4(CH_3)OH$	1	203.0	1.039	194.4
Dihydroxy Benzene (m)	$C_6H_4(OH)_2$	..	276.5	1.272	217.4
Quinoline	C_9H_7N	..	239.5	1.081	222.4
a—Naphthol	$C_{10}H_7OH$	..	279.0	1.224	227.9
b—Naphthol	$C_{10}H_7OH$	..	294.0	1.217	241.5

* Factor determined by dividing B. P. °C by Sp. Gr. and taken as the boiling point-specific gravity relation.

TABLE 3—Per Cent of Sample by Weight to Inhibit Growth of Fungus

Fraction	Specific Gravity					
	0.85-0.90	0.90-0.95	0.95-1.00	1.00-1.05	1.05-1.10	1.10-1.15
	Percent by weight required to totally inhibit growth of fungus—(agar-flask method)					
0°-210° C	0.05%	0.04%	0.02%	.....	.....	.....
210°-235° C	.....	0.04%	0.02%	0.01%	.....	.....
235°-270° C	.....	.....	0.20%	0.05%	0.01%	.....
270°-315° C	.....	.....	.....	1.00%	0.50%	0.05%
315°-355° C	Usually > 5% unless specific gravity exceeds 1.100					

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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

PRODUCT DEVELOPMENT in the PETROLEUM CHEMICAL FIELD

By RICHARD W. KIXMILLER
Celanese Chemical Corporation

The importance of product development work in the petroleum chemical field is emphasized both by the great growth in the volume of production of synthetic aliphatic chemicals and by the flexibility in processing operations provided through the present improved chemical technology. The latter makes possible the manufacture of a specific chemical by a variety of processes, in many instances, or the transformance of a specific product into other chemicals, depending on commercial requirements.

Three groups of markets open to new products of oil companies in the petroleum chemical field must be considered in organizing product development programs: (1) existing markets, (2) short-term markets, which in the main can be supplied from present facilities, (3) long-term markets requiring new capital investments. Examples are given of specific chemicals manufactured today from petroleum raw materials for these various markets, such as methyl ethyl ketone, normal propyl alcohol and tetrahydrofuran.

BEFORE considering in detail various problems of product development work in the petroleum chemical field, it will be helpful to review the general nature of organized product development work. This is an activity which only recently has come to play a specific part in the progress of a new chemical from synthesis on a small laboratory scale to commercial production in ton lot or tank car quantities. It has been defined recently as "the development of new products for existing uses."(1) It will be considered here, however, from a somewhat wider standpoint, as the commercial side of the research and development process.

It may be useful to think of product development studies as attempting to find an accurate and complete answer to the question, "How soon can a new company product be made a *useful and desirable* material for potential consumers—at *a price level profitable* both for the producer to manufacture and the consumer to use?"

Finding the Answer

Key phrases in the above question are italicized. The need for a careful and organized search to find the answer to this question becomes apparent after considering the many thousands of chemicals, some the result of brilliant experimental studies, which still lie dormant on laboratory shelves or hidden away in some handbook. DDT is an outstanding example of a chemical whose usefulness lay buried for many years after announcement of its synthesis and determination of its fundamental properties.

Under present industrial conditions, it is likely that synthesis of this chemical in a commercial laboratory would be followed by product development studies. These might include both application research in the same laboratory to determine potential fields of commercial usefulness, and also promotion of the material in the industry as a whole in the hopes that other laboratories might have better luck in applying the new material to solution of their individual problems. Certainly it could not be claimed that the usefulness of DDT would have been discovered 50 years sooner by such an attack, but likelihood of its discovery would obviously be more probable.

Present Importance Recognized

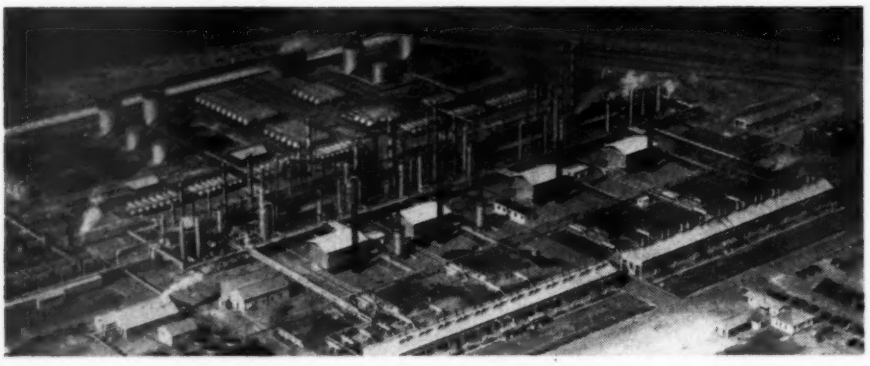
Product development work has been known in the chemical industry for many years. It is only in the past decade, however, that the complexity and changing markets in the industry, and the importance of the answers secured by an organized approach to its problems, have made product development an essential part of a profitable chemical undertaking. Twenty years ago, when the progress of a new chemical from laboratory synthesis to commercial production usually required from 5 to 10 years, product development could be a part time responsibility of an individual in research or sales groups. Since views of an individual regarding the commercial possibilities of a new chemical might be prejudiced because of lack of knowledge of potential fields of usefulness, and since the development period of new chemicals must now often be measured in months instead of years in order to stay ahead in a competitive market, it is found most desirable to organize a group with product development work as its specific responsibility.

But what has work of this type to

The Author

Richard W. KixMiller, Director of the Product Development Department, Celanese Chemical Corp., took his chemical training at Princeton University. He worked in the research laboratories of Standard Oil Co. (Indiana) on the polymerization of hydrocarbons to form lubricating oils and synthetic rubber, and joined the technical staff of the Office of Rubber Director, War Production Board, when the office was organized.

Commissioned Ensign U.S.N.R. in 1944, he was assigned to the synthetic rubber research and development program of the WPB and was later appointed assistant manager of research and development for RFC's Rubber Reserve Co. He joined Celanese in 1946 to direct the product development program of its Chemical Division.



Aerial view of the Bishop, Texas, plant of Celanese Corp., where raw materials from petroleum sources are converted into basic organic chemicals

do with the petroleum chemical field? The answer can be found in two major developments which have taken place in the industrial organic chemical field in the past 20 years. The first has to do with the tremendous change which has taken place in the raw material sources for the manufacture of aliphatic organic chemicals.

These chemicals (including the lower alcohols, ketones, aldehydes, glycols, etc.) were manufactured in 1925 overwhelmingly from two sources, fermentation and wood distillation. By 1945, however, over 50% of such chemicals were synthesized from petroleum or natural gas raw materials, and this percentage is steadily climbing. This tremendous change has taken place during a period of enormous growth in the production of synthetic aliphatic chemicals — from a total of 250 million pounds in 1925 to almost 9 billion pounds in 1945, approximately a 35-fold increase.(2)

Secondly, the great advance in chemical technology now makes possible not only the economical synthesis of a wide variety of organic chemicals known only as laboratory curiosities 20 years ago, but also provides unusual flexibility in this field, so that a certain chemical can be manufactured successfully by a variety of processes or, alternately, can be transformed into other chemicals, depending on current commercial requirements.

The tremendous growth in importance of petroleum raw materials for organic chemical manufacture, and the unusual process flexibility which exists in this field have increased many fold the importance of thorough product development studies in this section of the industry. No longer is it possible to embark on a research program leading to synthesis of a new chemical, or even undertake construction of a new plant, with some assurance that the market which existed for the proposed chemical at that time will be available two to five years hence when production is scheduled to begin. By that time, other chemicals will undoubtedly have absorbed a large proportion of the proposed uses, and consumer demand may be radically altered.

In order to stay abreast of this highly competitive market, it is necessary to maintain continuing product development studies in conjunction with laboratory research and development or new plant programs, so that such programs can be guided constantly by market trends, development of new uses, or obsolescence of old. It should be the aim of such work to maintain a current set of answers on all proposed new company chemicals to the question proposed earlier in this paper, and in addition to guide the company program towards consideration of other chemicals which appear to have potential interest for consumers.

Must Cover Wide Field

It should be noted that product development work is not confined to new chemicals, but must include studies of all new *company* products, even though they may be well known to the industry. However, somewhat different techniques must be used in the petroleum chemical field, since it includes materials whose end uses show wide variety. Some can be used directly by the consuming public. The antifreeze market which absorbs huge quantities of alcohols and glycols is a good example of this type of use. On the other end of the scale, consumption of some new chemicals may require extensive capital investment in additional research and plant facilities by other chemical companies. Problems involved in product development work obviously show a wide variation depending on possible end uses of each type of chemical.

Companies entering the petroleum chemical field have a choice of three broad groups of markets open to new company products: (1) existing markets, for materials already well known commercially; (2) short term markets, for new chemicals which can be used in existing equipment or formulations; (3) long term markets, which will require development work and new capital investment on the part of the consumer. These divisions are somewhat arbitrary, but are convenient for considering the different types of approach which product development work may involve. In some cases, a new chemical with a variety of possible uses will fall into more than one division. A discussion of specific chemicals manufactured today from petroleum raw materials and the product development techniques which might be used in each case will aid in illustrating the various types of problems involved.

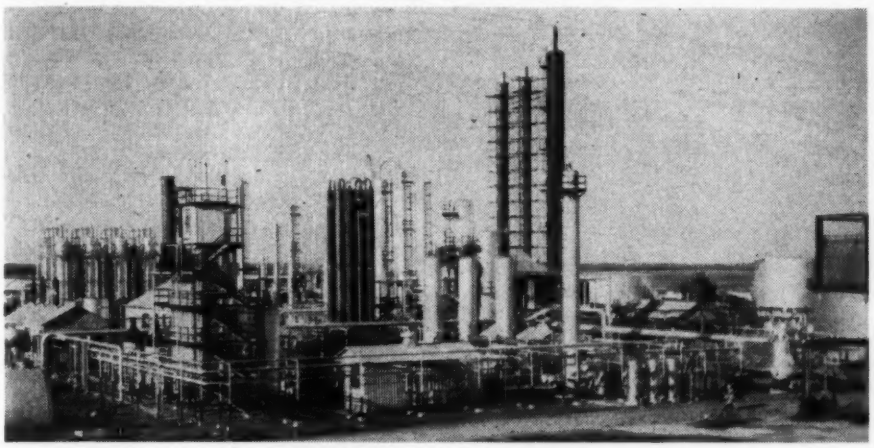
Example in Type 1 Market

Celanese Corp. of America in its new chemical plant at Bishop, Texas, oxidizes certain petroleum gas components, including propane and butane, to produce a variety of organic chemicals, including formaldehyde, acetaldehyde, acetic acid, acetone and methanol. During the past year, a number of new products from this plant have been introduced to the industry.

Methyl ethyl ketone is one of these new chemicals which falls into the type (1) market discussed above; i.e., an existing market for a chemical already well known commercially. This material has already been produced for a number of years by the oxidation of secondary butyl alcohol. It has an established market price, and is widely used by the industry as an effective solvent for various types of plastics in coating, casting and other operations, as well as a desirable ingredient in nitrocellulose lacquers. In addition, it is used in somewhat smaller volume in various solvent refining or extraction processes and as a chemical raw material for the manufacture of dyes and pharmaceuticals. Celanese in 1947 began large scale manufacture of methyl ethyl ketone in its Bishop plant.

The manufacture of this chemical by a new process obviously required a research and development program which went through the usual stages from the laboratory through the pilot plant and the extensive engineering and process studies necessary for large scale plant design. What product development work was necessary in order to insure a sound decision on the desirability of embarking on a large scale plant program? In this case, answers to the question proposed earlier could be secured relatively easily by a market research study. Price level was established, chemical and physical properties and uses were well known and some figures on volume of production were available.

A survey of users indicated their needs for this solvent were increasing and that present producers were not keeping pace with the demand existing at the established price. Cost



Propyl alcohol production and purification unit at the Bishop plant

estimates had shown it would be possible for Celanese to produce MEK and sell it at the market price at a profit so the answer to the question, "How soon can this new company product be made a useful and desirable material for potential consumers —at a price level profitable both for the producer to manufacture, and the consumer to use?" was obvious. The sooner production could be started the better.

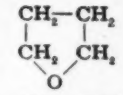
If the demand had not been as apparent, a more detailed study would have been necessary, including, if possible, complete information on the following points: (1) previous price and volume trends on this chemical, indicating its relative stability as compared to overall industrial trends; (2) possible obsolescence of present uses or development of new ones in the light of competitive materials; (3) estimates of extended uses and increased demand if price were reduced; (4) available information on planned production expansions for the same or competitive materials by other companies.

Developed for Short-Term Market

As an example of the second type of market for petroleum chemicals, the short-term market, the production by Celanese of normal propyl alcohol can be mentioned. This chemical, whose production in tank car quantities started at Bishop early in 1947, was heretofore known commercially to a limited extent. It was a new material to the majority of its present users. It could, however, be utilized in existing equipment or formulations, and its relative newness was tempered by the fact that it is a straight-chain primary alcohol, and as such a member of a series of chemicals whose properties are already extremely well known to industry. Moreover, members of this series on either side of n-propanol—i.e., ethanol and n-butanol — are among the most popular industrial solvents in the lacquer, coating and finishing fields and have other important industrial uses as well. Because of this situation, almost as much information was available to evaluate the market for n-propanol as if this material had been well known commercially.

Market research studies similar to those discussed previously for methyl ethyl ketone were made, which indicated a severe shortage for both ethyl and butyl alcohols, even at the high prices secured for these materials when manufactured from vegetable sources by fermentation. Samples of n-propanol distributed to the trade indicated this alcohol could be used to modify or supplement existing formulations in solvent, hydraulic fluid, and other similar end uses. Because of these facts and the ready acceptance of this material by the trade, it was possible to accelerate large scale production of n-propanol and begin tank car sales sooner than had originally planned.

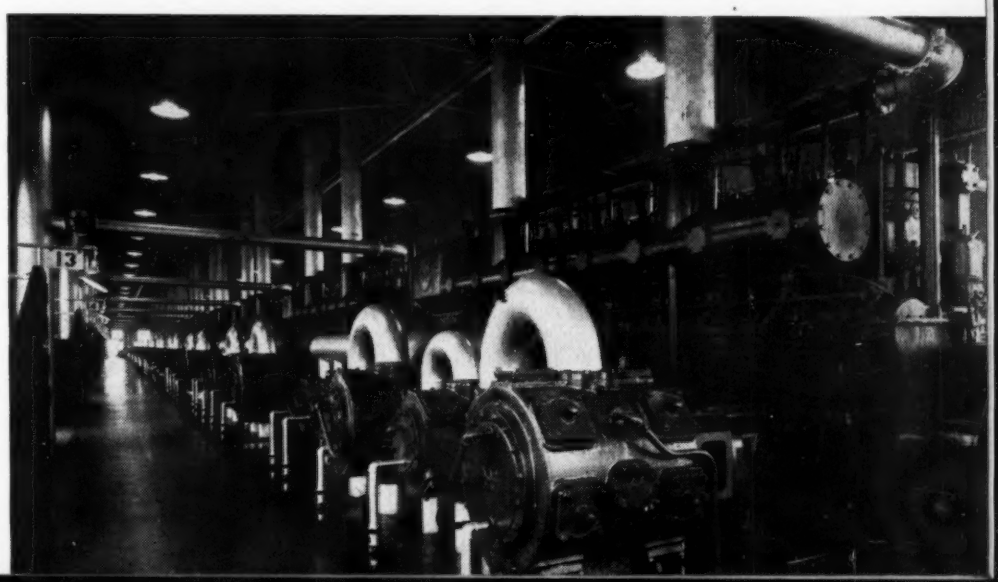
Another case of a chemical which belongs in the short-term market group; i.e., can be used in existing equipment or formulations, presents quite a different picture. This material, tetrahydrofuran, is now in limited commercial production at the Bishop plant. Its main uses so far have been as a premium solvent for various types of plastics and resins. However, instead of being a new member of a well known group of compounds, which would enable fairly accurate predictions of price, market, and uses as in the case of n-propyl alcohol, tetrahydrofuran is a member of a class of compounds entirely unknown commercially in this country. It is a four-carbon cyclic ether with the formula:

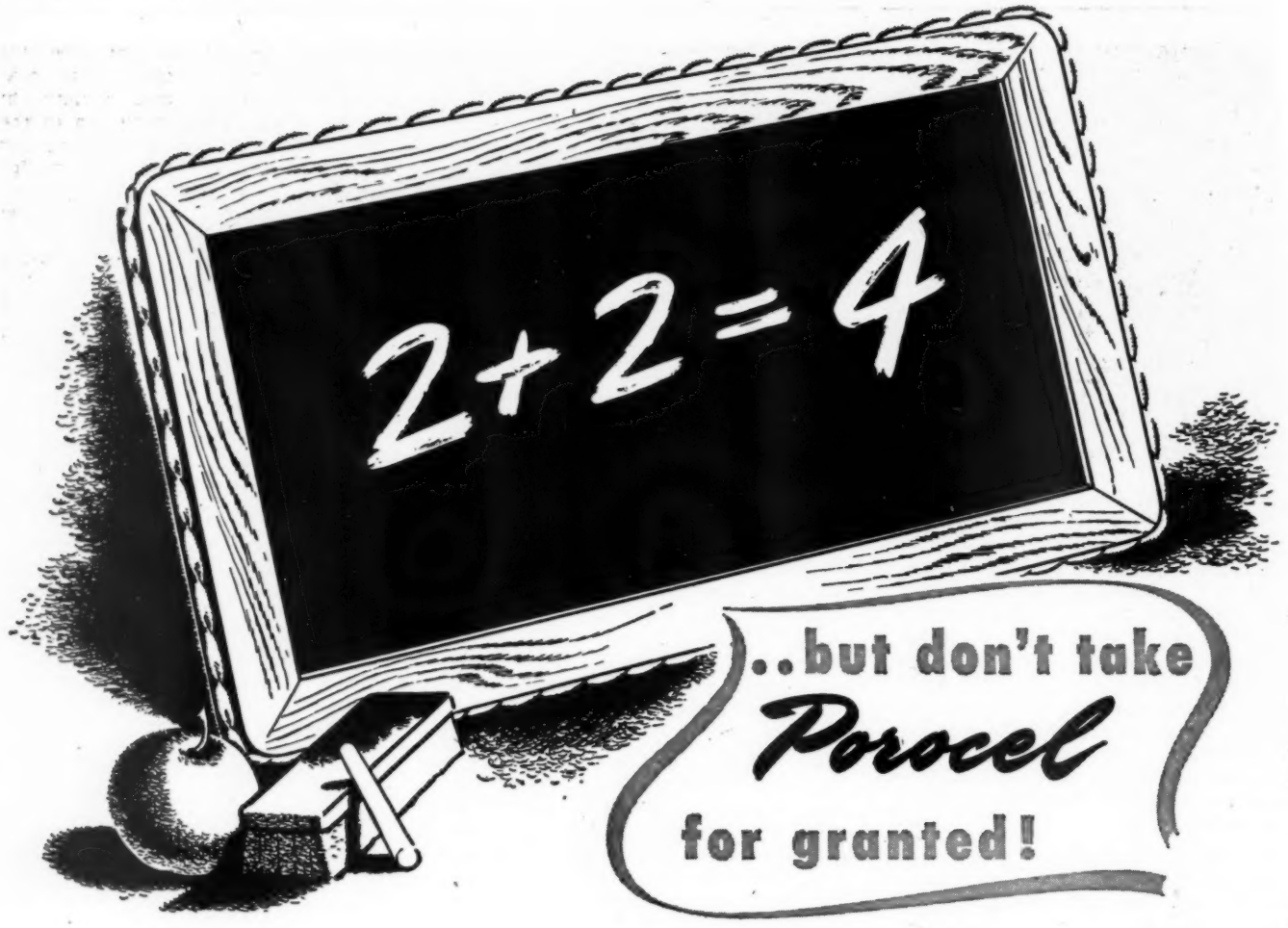


In such a case, product development work actually starts with a thorough literature review to uncover all available information on possible end-uses of this chemical, or data on properties which may give indications of such applications. It was found that considerable work had already been carried out in Germany on this chemical, and that it had some outstanding properties as a solvent medium for certain chemical reactions, and also that it compared favorably with other well known solvents for forming unusually high solids solutions of various natural and synthetic resins.

There were also indications that the chemical properties of tetrahydrofuran might lead to the consumption of this chemical as a raw material for other important products. Consequently, tetrahydrofuran, with possible use as a solvent to replace other materials, could probably be utilized in existing equipment, and therefore fits into the short-range market category. Its application as an intermediate would require development work and probably new plant construction, so that this latter use would fall in

One of the largest installations of gas-driven compressors in the country is at the Chemcel plant of Celanese at Bishop, Texas





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the third market group, the long-range type.

Even for short-range markets, however, the relatively unknown commercial value of the characteristics of tetrahydrofuran made it impossible to arrive at any reasonable price or potential volume estimates. Consequently, after some application research in Celanese laboratories to confirm its potential usefulness as a solvent and to secure some information to assist users in an initial consumer study, an advertising and sample distribution program was begun in order to allow experimental work in laboratories of other companies. A program of this kind, begun when tetrahydrofuran was in pilot plant production, is necessary on a new chemical in order to secure first hand information from potential consumers as to the value or limitations of the product in solving their problems.

Comments from users in this stage are usually very helpful and often are absolutely essential in guiding commercial development of a chemical. For instance, it may be possible to eliminate an extra purification stage planned for a large scale plant, thus lowering the price and widening the market, if development work by consumers indicates that high purity is not necessary for a wide majority of uses. Furthermore, it is possible to make tentative price and volume estimates on the basis of customers acceptance, which in some cases is necessary before commitments on large scale plant construction can be made.

Product for Long-Range Market

The problem of developing a chemical which fits in the third market category—the long-range market—is the most difficult of all, yet it is the field which may benefit a company most effectively over a long period of time. Here is the job of combining two unknown potentialities, a chemical whose existence may be known only as the result of a few academic experiments and a field of usefulness which is merely a vague idea in the mind of some investigator.

As an example, Celanese is now producing propionaldehyde at Bishop in limited quantities. By a well known series of reactions, this material could be converted through the aldol and subsequent dehydration to the unsaturated aldehyde, α-methyl β-ethyl acrolein, as shown in the following diagram:

$$2CH_3 \cdot CH_2 \cdot CHO \xrightarrow[\text{Low Temp.}]{\text{NaOH}}$$

Propionaldehyde

$$C_2H_5 \cdot CHOH \cdot CH(CH_3)CHO \xrightarrow{\text{Heat}}$$

Propionaldol

$$C_2H_5 \cdot CH{:}C(CH_3)CHO + H_2O$$

α-Methyl-β-ethyl acrolein

But would this product be useful from a commercial standpoint, assuming that its manufacture appeared to be feasible? Product development work must help to supply the answers to questions like this.

Because of the properties of the aldehydes, particularly the unsaturated ones, it is doubtful that this material might have any direct entrance to a consumer goods field, since these compounds are notably poisonous and unstable. It is most likely that this compound might find a place as a chemical raw material from which other useful chemicals could be made. Therefore, it is likely that in this case product development work will require a considerable period of time, since other companies must test it, develop appropriate processes, design and build plants, and quite possibly carry on a product development job on the derivative, before large volume sales of this chemical can be consummated.

Various Outlets Seen

Several chemical reactions will immediately suggest themselves as possible useful outlets for α-methyl-β-ethyl acrolein, to form products useful as solvents, plasticizers, or plastic raw materials:

$$C_2H_5 \cdot CH{:}C(CH_3)CHO + 2H_2 \xrightarrow[\text{Hydrogenation}]{}$$

$$C_2H_5 \cdot CH_2 \cdot CH(CH_3)CH_2OH$$

2-Methyl-pentanol

$$2C_2H_5 \cdot CH_2 \cdot CH(CH_3)CH_2OH$$

$$+ \text{Phthalic anhydride} \xrightarrow[\text{Esterification}]{}$$

Hexyl phthalate

$$C_2H_5 \cdot CH{:}C(CH_3)CHO \xrightarrow[\text{Oxidation}]{}$$

$$C_2H_5 \cdot CH{:}C(CH_3)COHO$$

2-Methyl-pentenoic acid

$$C_2H_5 \cdot CH{:}C(CH_3)COHO \xrightarrow[\text{Esterification}]{}$$

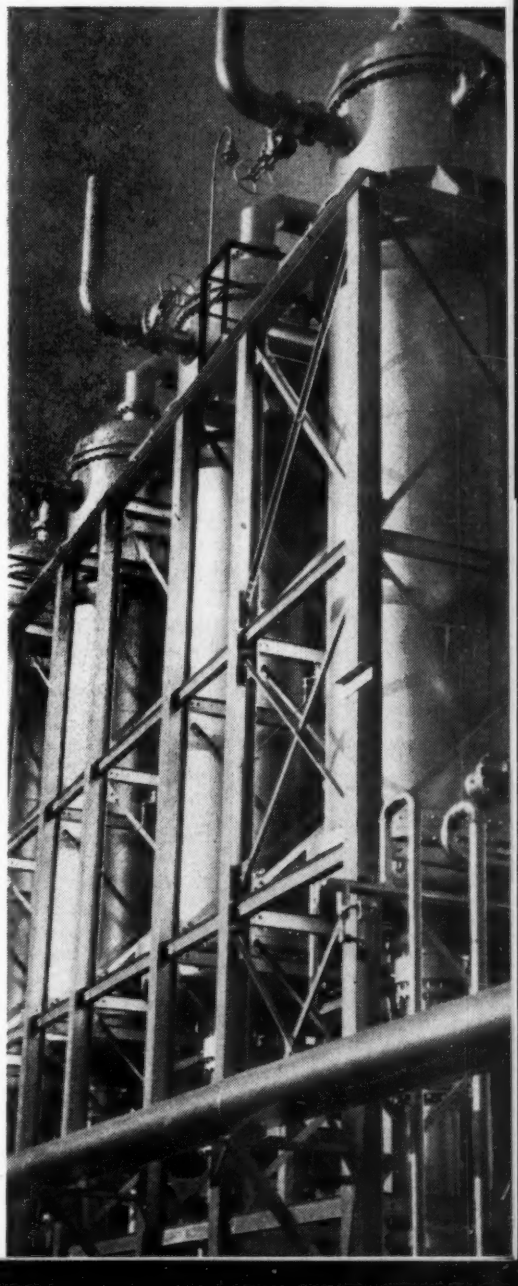
$$C_2H_5 \cdot CH{:}C(CH_3)CO \cdot O \cdot CH_3$$

It is possible, however, that some of these reactions do not work with this material. Furthermore, it is desirable to have a background of information on the stability, physical characteristics, and general chemical properties of a new material such as this before samples are distributed to outside companies. After an extensive literature survey, it would probably be advisable to carry out certain application research studies on the use of this chemical as an initial part of the product development program. These studies should help to answer questions which might be asked by interested consumers, and therefore should be guided closely by product development personnel who are familiar with consumer problems in this field.

Some companies also feel that application research work on a particularly interesting compound is advisable from a patent standpoint. Under anti-trust decisions, it is not possible to maintain a monopoly on a use of a material which is sold on the open market through patents held by the same company. However, such patents would bar granting of patents in the same field to another company which might utilize them to restrict use of the chemical in this field.

Even if a literature survey and preliminary application research do not uncover any important commercial possibilities, it may be desirable to carry to a larger scale work on a new material such as α-methyl-β-ethyl acrolein, if results of laboratory studies are favorable. As soon as possible after pilot plant work has begun, product development work should begin with

Multiple reactor units for the production of chemicals from natural gas at the Chemcel plant of Celanese Corp.



outside companies whose interests lie in fields where this may fit. An advertising program may also be undertaken to bring the possibilities of this new material to the attention of potential industrial users in fields which might not even have occurred to the producer. The chemical consuming industry is so complex and specialized today that a very broad coverage of the industry is essential if the commercial possibilities of a new compound are to be effectively surveyed and exploited. Ramifications of even the largest companies' research studies are not broad enough to secure complete evaluation of the potential uses of a new compound.

As mentioned previously, the importance of early cooperation with consumers on a chemical such as this substituted acrolein is increased because of the length of time necessary for consumer studies. For instance, if a particular company felt this chemical had possibilities as a raw material for plasticizers, it would be necessary for it to manufacture a series of compounds, choose the most promising and compare them with known products and finally, through a further series of product development studies, determine the interest and secure an evaluation by another group of consuming companies, who also might have to make a field survey to test reactions of their customers. The lengthy duration of such a series of evaluations is obvious, and the problem of equating price all along the line is most difficult, particularly since volume tests are necessary for accurate cost and value estimates in each step. Such a waiting period may be particularly hard on the initial producer, since he must have some indication of price and volume before constructing a larger plant.

This is obviously an extreme case. Indeed, it is the practice of many companies to avoid such difficulties by attempting to integrate outside sales of materials with their own process studies. Thus a company may have developed a series of reactions, going through several steps, to manufacture a material necessary for a particular market under its own control. Several of these chemicals formed in intermediate steps may be almost unknown to the industry at large. Since, however, they are already connected with large scale operations, product development work can be carried out on them over a long period of time with little difficulty. Sample quantities will be available when required, and production experience has already resulted in accurate cost estimation so that an ultimate market price with commercial significance can be established.

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Summary

This brief survey has emphasized the importance of product development problems in the petroleum chemical field. Since an industrial research program has as its goal the development of profitable processes and products, a well organized product development group is of great assistance in furnishing facts to help guide this program, and in shortening the time interval between laboratory studies and profitable commercial sale. It also is obvious that a product development staff depends strongly on research and plant engineering groups for accurate information on new processes, costs, and supplies of new chemicals. By close liaison and effective cooperation between these groups, guided by progressive management, rapid development in the petroleum chemical industry can be continued.

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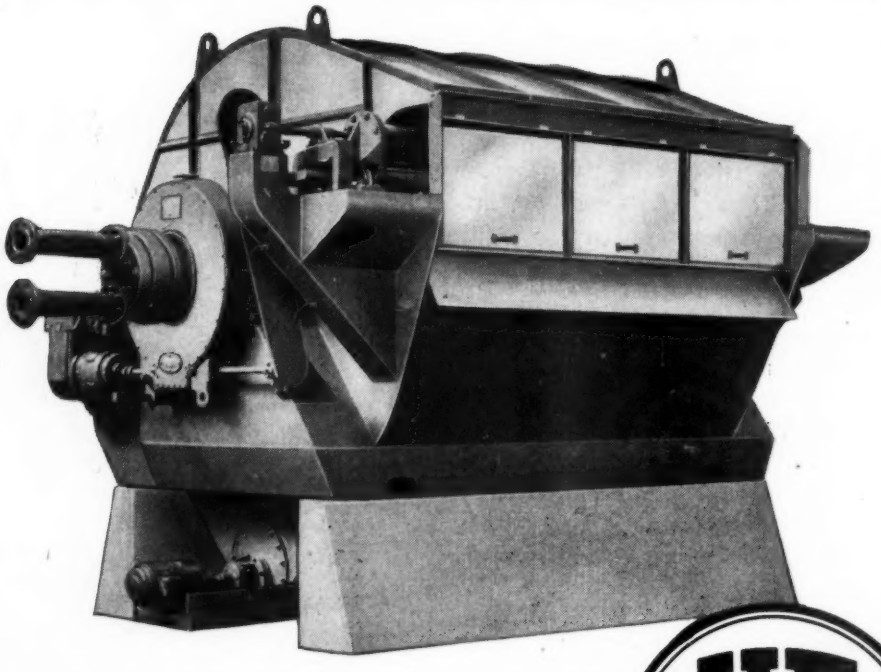

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Three-Level Organization Is Key To Successful Safety at Utopia

By FRANK J. SLUZE, Safety Director
Ashland Oil & Refining Co., Ashland, Ky.

UP TO NOW we have dealt with visual inspections. This month's review will cover the safety committee organization and employes' safety inspections at this mythical Utopia Refinery.

First, we learn that safety committees are organized on a three-level basis. The top level, known as the central safety board, is company-wide in scope, the Utopia refinery being only one division. This board includes the heads of several major departments in the company such as personnel, purchasing, production, transportation, marketing, and of course, refining.

The company president is chairman of the central safety board. The group meets quarterly to decide upon policies, major expenditures, educational work, and mass promotional programs. Its agenda is determined before each meeting and is influenced by accident costs and trends, the necessity for major appropriations, and recommendations submitted from the other two committee levels.

The second level in the organization is the refinery supervisory safety committee, composed of all supervisors in the plant, and with the general superintendent as chairman. Meeting once a month, it decides upon suggestions made by the several employes' safety committees and corrections proposed by the employes' inspection committees. It also works out steps to be taken in putting into effect all policies laid down by the central safety board.

Most Important of the Three

This is the most important of the three committees because of its liaison position between those above and below its own level. Its meeting agenda, of course, is influenced by decisions and recommendations coming from both directions.

The third level in the organization includes the several craft or departmental committees, which meet twice monthly on company time. They select their own officers. To give as many employes as possible a chance to serve, the terms of office are limited to three months. The agenda for meetings is an established order of business, and is best illustrated by a case in point:

Reviewing injury reports, the committee learns that head injuries are occurring too frequently and are being caused by objects falling on heads of workers below.

The committee concludes that providing toe plates on overhead structures and hard hats for workmen will go a long way toward solving the problem. They learn that such a recommedation will require an expenditure of $1080 for the hats and $2560 for material and labor to install toe plates on all overhead decks and walkways. Accordingly, an approval is requested from the central safety board for this expenditure.

The central board learns, after study, that the cost of all head injuries far exceeds the proposed cost for hats and toe plates. Prompt approval is therefore given with the suggestion that action be taken as quickly as practical.

Inspections

Now let's take a look at the employes' inspection activities. We learn that each craft or department appoints one employe to represent them on the inspection committee. These appointees serve a term of three months, thus rotating the membership among as many workmen as possible. The safety engineer notifies the members, through their foremen, when the committee is scheduled for a plant inspection. All hands assemble at the appointed time and place. One man is chosen as secretary and provided with a pad and pencil.

Utopians realize full well that these inspections are not a field day for gripes but are intended to be constructive. They are also aware that unsafe acts cause more injuries than unsafe conditions, so their attention is focused on the behavior of workers as well as on equipment. As soon as an inspection committee member spots a dangerous act or condition, he calls out the fact to the secretary, who makes a note of it.

Let's go along with this committee on its trip around the refinery. We notice the safety engineer guides their activities along constructive lines. One of the committee members sees an insulator working on some overhead piping. He checks to see if the ladder is secured safely. All's well—the ladder has been lashed in place with a chain, equipped with a harness snap. Utopia safety regulations require ladders to be lashed or held.

Another committee member notices that access to the back of an electric switch with exposed parts is not guarded by a screen. He reports the matter to the secretary who enters the item in his notes.

Traffic warning signs such as these on Utopia Refinery roadways are one of the many safety regulations carefully watched by Inspection Committees

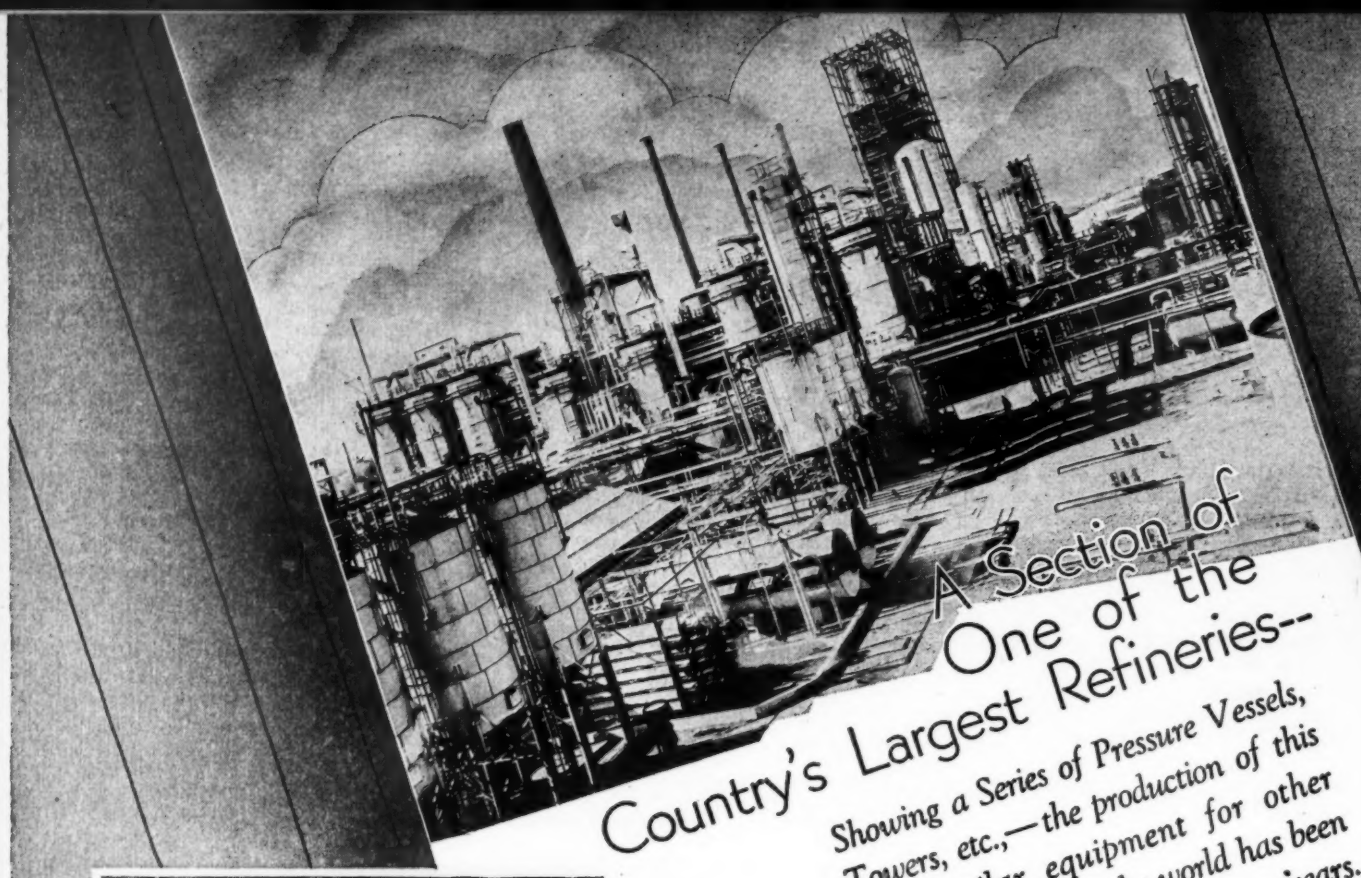
Moving through the operating area, another member sees a workman with his sleeves rolled up. This is an unsafe practice because it exposes the arms to possible burns from hot oil or steam drips, welders' sparks, or direct contact with hot lines. He turns this in to the secretary with the suggestion that the worker's foreman be informed.

Proceeding further, another member discovers a pump spewing gasoline. Closer inspection reveals it is coming from the packing gland and considerable spillage has been formed. There is no time for noting this in the report. It must be corrected at once. The safety engineer calls the chief machinist and requests a mechanic be sent immediately to tighten the leaking gland. He also calls the unit operator and suggests that the pool of gasoline be washed away at once.

Safety Engineer's Job

Someone must carry out the suggestions made at safety meetings and by inspection committees. The safety engineer has been hired to devote all of his time to prevention of accidents and fires, so it naturally follows that his is the responsibility for following through on the activities of all safety groups within the company and for sparking the safety movement through all three levels of organization.

To provide him with the opportunity to fulfill his duties efficiently, he serves as secretary of the central safety board and the supervisory safety committee, and sits in on employes' meetings as a consultant.



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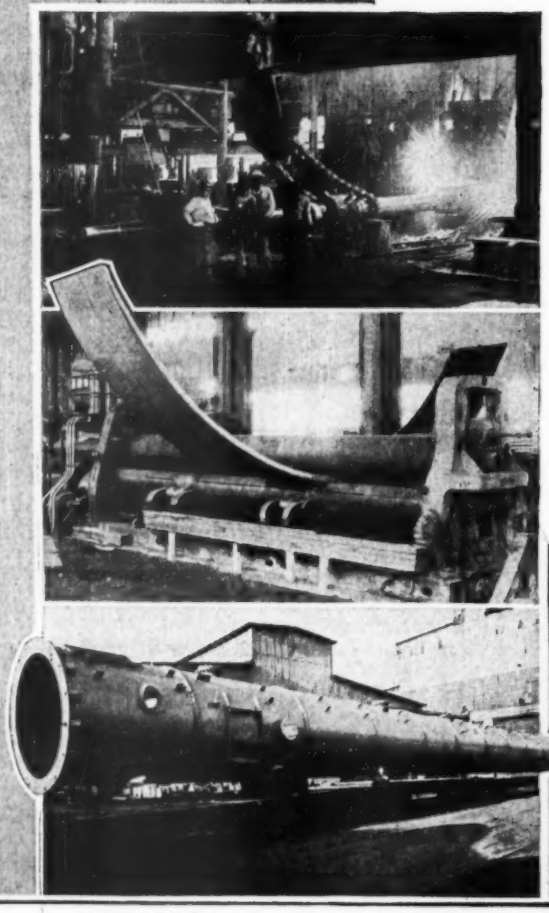

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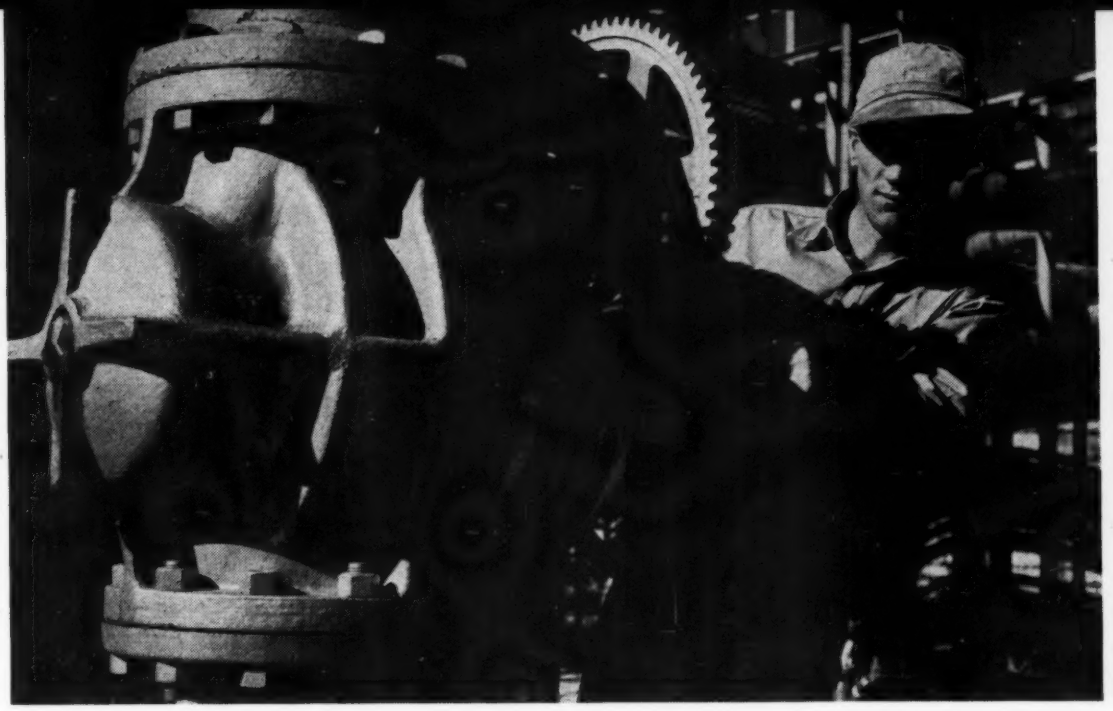

Photo above is a low-pressure, intermediate-type, plug valve, operated by a spur gear. Large size of this particular valve precludes wrench operation, but it can be lubricated by a grease gun. It should be lubricated at least once monthly, moved slightly, and adjusted to prevent leaks and assure positive shut-off as required

MAINTENANCE OF PLUG VALVES

By ROY E. BUSH, Nordstrom Valve Division
Rockwell Manufacturing Co.

Plug valve misfunctioning generally is due to improper maintenance or misapplication in service. Decreased plug life also results from using plug valves for throttling service. Along with regular maintenance it is important that the proper lubricant be used. Service limitations and special maintenance problems peculiar to each of the three general types of plug valves are described. A general plant valve maintenance group or department is recommended.

The material and illustrations in this article originally were presented by the author under the title, "Maintenance and Operation of Plug Valves", before the Plains Regional Meeting of the Natural Gasoline Assn. of America, at Amarillo, Texas, Dec. 12, 1947. The following article is an expansion of the original text and includes information given in answers to questions asked the speaker at the meeting.

THE plug valve and its close relative, the stopcock, probably is the oldest and simplest of all the various types of valves, perhaps the most abused, and certainly is tending to become the most numerous in the newer refineries and natural gasoline plants. In a large plant the investment in plug valves alone is a considerable item, with prices for individual valves ranging about $6 to $4000.

As with most simple mechanisms, maintenance is simple; yet, as with every kind of good mechanical equipment a certain amount of attention and thought must be given to proper operation. The majority of troubles developing with plug valves can be laid to improper maintenance or installation in services which the individual valve was not designed to handle. In the former case, trouble generally develops from using the wrong lubricant or, more properly, "plastic sealer", or no lubrication at all.

A third cause of difficulty is the use of the plug valve for throttling service, a practice not recommended by valve manufacturers. Lacking a satisfactory substitute for severe applications, however, operators who use it for throttling anyway must expect increased maintenance cost as a normal consequence.

Service Misapplications

The service limitations for any valve are set by one or more of three factors; temperature, pressure, and fluid to be handled. Temperature and fluid normally govern the selection of lubricant also.

Trouble calls in the plant seldom reveal valve controlling pressures exceeding the rated maximum. A notable exception is an oil field case where a 1500 psi. Christmas tree was installed on a well but a 150-lb. cast iron valve was found in the flow line. Generally the misapplication is from the temperature standpoint and ordinarily has been overlooked when valve specifications were drawn up.

A typical case of mismatching valve and service was found recently in a large refinery. An immovable plug was reported on a heat exchanger valve where pressure ranges from atmospheric to 12 psi. and tem-

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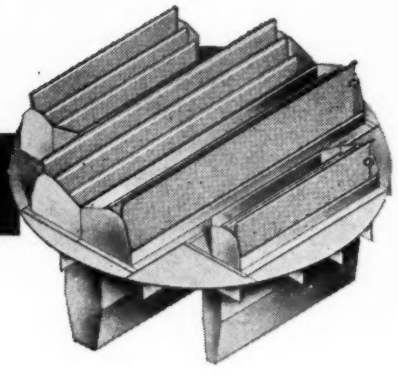

Plug Valve Maintenance

perature from atmospheric to 550° F. Upon inspection it was found the valve was a standard 150-lb. valve. This type of valve, made from cast iron, is rated for temperature not to exceed 125° F. principally because of the packing used. In this case the temperature limitation was completely overlooked in selecting the valve to be installed, with unsatisfactory operation and expensive downtime a consequence.

Another common misapplication is the use of standard valves on flowlines where subatmospheric temperatures may be encountered, a butane or propane system is a good example. Most standard valves have cast-iron bodies, which lose strength rapidly as temperatures decline. Should the valve be under a strain exerted by the pipe, or if it should receive a sharp blow, the valve may be broken or rendered inoperable at low temperatures. This also is true of the intermediate type of valve with cast-iron body. Intermediate type valves with steel bodies, or the high pressure type, should be employed for temperature extremes.

A great many types of lubricants, designed for different services, are stocked by most plug valve manufacturers. The same type of lubricant generally is stocked in two consistencies for stick or gun application, and the latter method is growing in popularity. One company, for example, lists 24 "standard" lubricants and advises its customers that other lubricants for unusual services involving special conditions are available on special order. Comment on properties of one of its lubricants is typical:

"This lubricant is especially adaptable for hot oil services where no moisture is encountered. Has poor resistance to acids and is very soluble in water or aqueous solutions. Possesses excellent resistance to naphthas, oils and certain organic solvents over a fairly wide (50 to 350° F.) temperature range. Absorbs water readily, therefore must be protected from moisture continuously."

Recommended services include hot

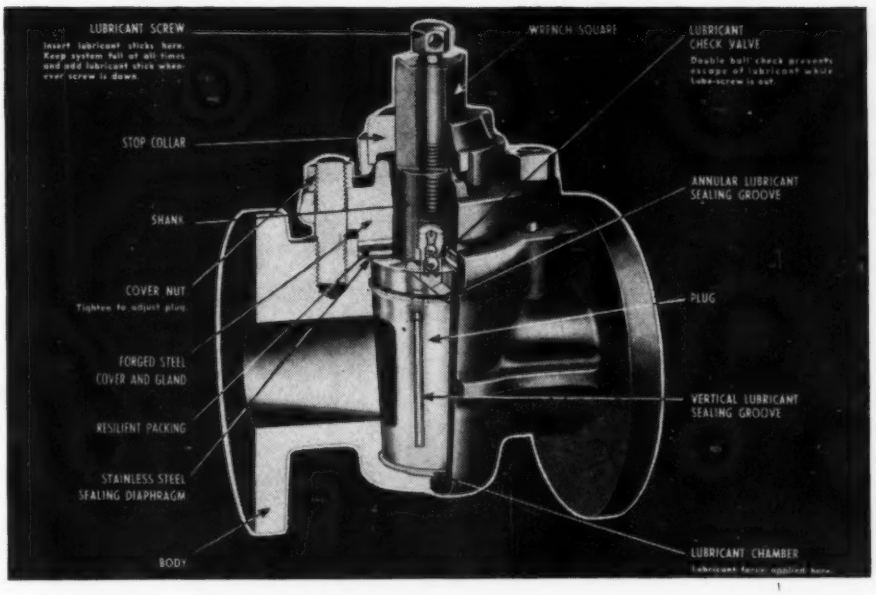
LUBRICANT SCREW
Insert lubricant sticks here. Keep system full at all times and add lubricant stick whenever screw is down.
WRENCH SQUARE
LUBRICANT CHECK VALVE
Double ball check prevents escape of lubricant while lubescrew is out.
STOP COLLAR
ANNULAR LUBRICANT SEALING GROOVE
SHANK
COVER NUT
Tighten to adjust plug.
PLUG
FORGED STEEL COVER AND GLAND
VERTICAL LUBRICANT SEALING GROOVE
RESILIENT PACKING
STAINLESS STEEL SEALING DIAPHRAGM
BODY
LUBRICANT CHAMBER
Lubricant forces applied here.

Fig. 1—Right top: standard type plug valve. Cover also functions as the packing gland

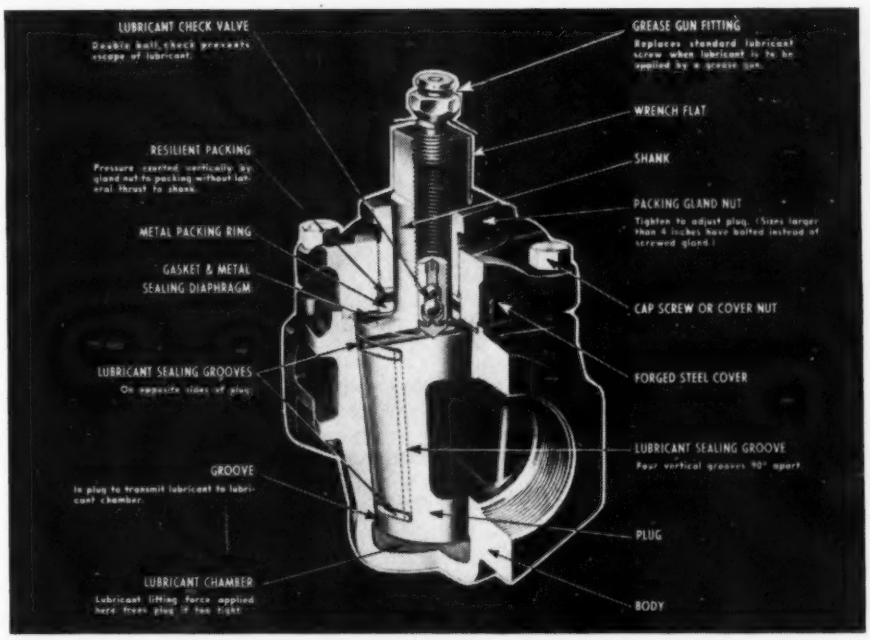
LUBRICANT CHECK VALVE
Double ball check prevents escape of lubricant.
GREASE GUN FITTING
Replaces standard lubricant screw when lubricant is to be applied by a grease gun.
WRENCH FLAT
RESILIENT PACKING
Pressure exerted vertically by gland nut to packing without lateral thrust to shank.
SHANK
PACKING GLAND NUT
Tighten to adjust plug. (Sizes larger than 6 inches have bolted instead of screwed gland.)
METAL PACKING RING
GASKET & METAL SEALING DIAPHRAGM
CAP SCREW OR COVER NUT
LUBRICANT SEALING GROOVES
On opposite sides of plug.
FORGED STEEL COVER
LUBRICANT SEALING GROOVE
Four vertical grooves 90° apart.
GROOVE
In plug to transmit lubricant to lubricant chamber.
PLUG
LUBRICANT CHAMBER
Lubricant lifting force applied here frees plug if too tight.
BODY

Fig. 2—Right center: intermediate type plug valve has screwed or bolted packing gland, separate from cover. This construction will withstand greater temperatures and pressures than will standard valve

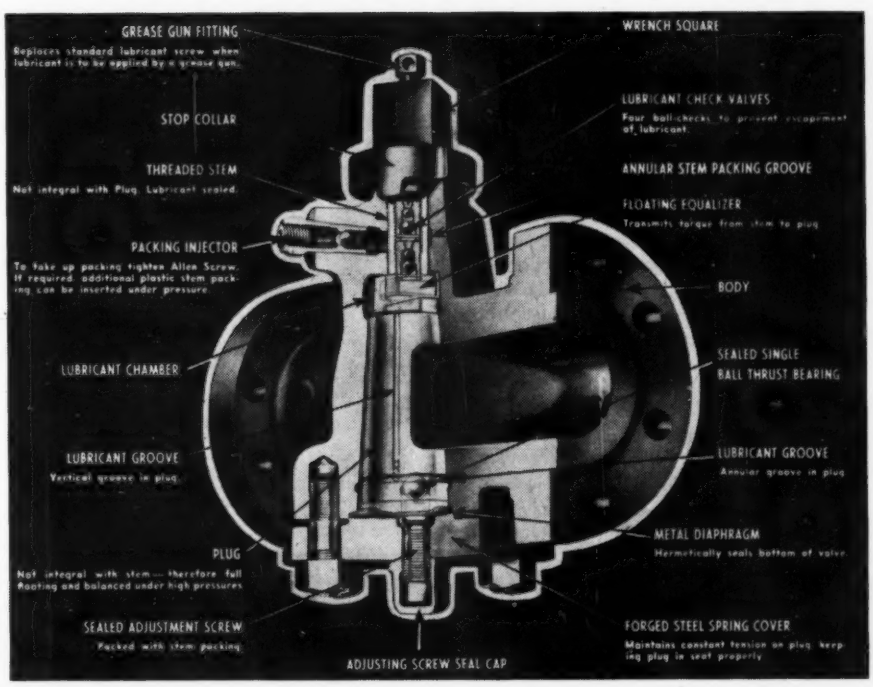
GREASE GUN FITTING
Replaces standard lubricant screw when lubricant is to be applied by a grease gun.
WRENCH SQUARE
LUBRICANT CHECK VALVES
Four ball-checks to prevent escapement of lubricant.
STOP COLLAR
THREADED STEM
Not integral with Plug. Lubricant sealed.
ANNULAR STEM PACKING GROOVE
FLOATING EQUALIZER
Transmits torque from stem to plug
PACKING INJECTOR
To take up packing tighten Allen Screw. If required additional plastic stem packing can be inserted under pressure.
BODY
SEALED SINGLE BALL THRUST BEARING
LUBRICANT CHAMBER
LUBRICANT GROOVE
Vertical groove in plug.
LUBRICANT GROOVE
Annular groove in plug
METAL DIAPHRAGM
Hermetically seals bottom of valve.
PLUG
Not integral with stem — therefore full floating and balanced under high pressures.
SEALED ADJUSTMENT SCREW
Packed with stem packing.
FORGED STEEL SPRING COVER
Maintains constant tension on plug, keeping plug in seat properly.
ADJUSTING SCREW SEAL CAP

Fig. 3—Right bottom: high-pressure plug valve uses packing to prevent stem leaks only; it will withstand extremes of pressure and temperature. It may be repacked as well as lubricated under full service conditions

Maintenance and Repair Tips

The care and maintenance suggestions for lubricated plug valves which follow, in addition to those in Mr. Bush's paper, include several based on questions coming from the audience after the paper was presented.

1. After servicing a valve, be sure that the valve lubricant chamber is left freshly packed and nearly full. This assures enough lubricant is available in emergency to permit operation of the plug should it show signs of sticking in its seat. In standard and intermediate valves, a quick shot of lubricant may help seal off a leak in an emergency until the proper maintenance measures can be taken.

2. The lubricant in the valve as it leaves the factory is an "assembly lubricant". This may or may not be proper for the service to which the valve may be assigned. To be sure the right lubricant is in the valve, displace the "assembly lubricant" with the lubricant known to be proper. Your valve manufacturer can tell you how much lubricant capacity a specific valve of his make has; for example, the usual 4-in. plug valve will hold 6 to 8 sticks of lubricant when entirely empty.

3. After valves have been lubricated, plug should be moved in *both* directions several times to insure quick and easy operation *unless* special operating requirements prohibit this practice. In the latter case, move the plug *very slightly* in both directions. Position of plug, i.e., fully "open" or "closed," is immaterial during lubrication.

4. Always use the wrench furnished for the valve. A too-common practice is to use pipe wrenches, which ruin the operating shank. Shanks have been cracked by this careless practice. The proper wrench should be left in place on the shank or attached to the valve by any convenient means where permissible. *Don't* use a "cheater" or other means to secure additional leverage on the wrench in case of a stuck or tight plug. You may be lucky and only break the wrench, moderately unlucky and twist off the stem, or unlucky and break the valve. Likewise, don't use a hammer.

5. There is little danger of breaking a valve from excessive lubrication pressure. In the field the generally observed tendency is toward insufficient rather than excessive lubrication.

6. In cases where the required lubricant may be harmful to the fluid in the line care should be observed not to over-lubricate. When loading the valve with lubricant, by either jack-screw or gun, the operator can feel the pressure build up to a maximum which slacks off almost instantly when the plug is lifted from its seat. Do not continue to feed further lubricant after this occurs.

7. Valves in a high-pressure absorption plant operating at service temperatures in excess of 350° F. should be lubricated once each shift. This is a good rule to follow wherever high temperatures are involved.

8. Always tag both body and plug when a valve is dismantled for any reason. Plugs are fitted to the body by lapping and are not interchangeable. When a replacement plug is installed (most manufacturers stock them in 0.0625, 0.125 and 0.25 in. oversize) it must be lapped to fit.

9. Never remove *all* bolting on valve cover plates unless the plug is movable, or if the plug is stuck in the "closed" position. In the first place, lubricant under very high pressure may be trapped in the reservoir and cause the plug to leave the body with considerable velocity. Second, corrosive, dangerous or high pressure fluid may be trapped in the plug orifice.

10. Always store new or repaired valves with plug in the full "open" position. This will protect lapped surfaces of plug and body against grit, dirt and the like and minimize possible rusting.

11. Always fill the valve with the proper lubricant after repairing. Note on the identification tag the lubricant to be used for future reference.

There doubtless are other good tips which can be added to the above list. It should be noted in applying these that, in some cases, company safety rules or service conditions may be abridged; in this case individual company requirements should be followed. The main thought is to give the valve a chance to demonstrate the long troublefree life it is capable of furnishing, and to that this article is dedicated.

oil, absorption oil (both fat and lean), hot naphtha and naphtha vapors, carbon tetrachloride, carbon disulfide, and hot lubricating oils free from water or acid.

The usual case of lubricant misapplication involves the wrong temperature range or fluid attack on the lubricant. Often the operator or maintenance crew is found guilty of using whatever lubricant is handy without regard to its suitability.

Need for Systematized Maintenance

Most valves do not need frequent attention, except when in severe service. Then the axiom should apply, "the more severe the service the more frequent the maintenance." The most satisfactory plan in any plant is to vest responsibility for valve maintenance in a single individual or, if the installation is large, in regular maintenance crews.

One large oil company requires that no operator in refineries or natural gasoline plants be permitted to do more than operate the valves at his unit or plant except in extreme emergency. When leaks develop he reports to the maintenance crew. Every valve in the plant, whether regularly operated or not, is lubricated, adjusted if necessary and moved at least slightly once a month. More frequently-used valves are serviced weekly and a few daily. Some critical-service valves in plants of several other companies are serviced once each shift.

Various types of charts and valve service-cards are used by some of the larger oil companies in keeping track of valve attention. One good system employs a "check-chart" at the individual unit, plus valve-cards kept by maintenance or inspection departments.

At each unit in one plant, a so-called "check-chart" is kept in the control room. Every valve on the unit is given a code number on a schematic flow diagram of the installation, and below the flow diagram this coding appears on a form with squares to one side. Provision for dates is made above the squares. Each time a valve is serviced by the maintenance crew a check-mark is made opposite every valve involved. (Some charts show if the valve was adjusted as well as lubricated.) Then, if a valve "acts up", the supervisor can tell at a glance when it was last serviced (sometimes the extent of the servicing) and whether or not the specified maintenance time-cycle had elapsed between servicings.

At the same time the service crew notes what was done on the valve record. This or a master record also may show type of valve, service, specified lubricant and the complete maintenance history of the valve from acquisition to date, including repairs and engineering inspections.

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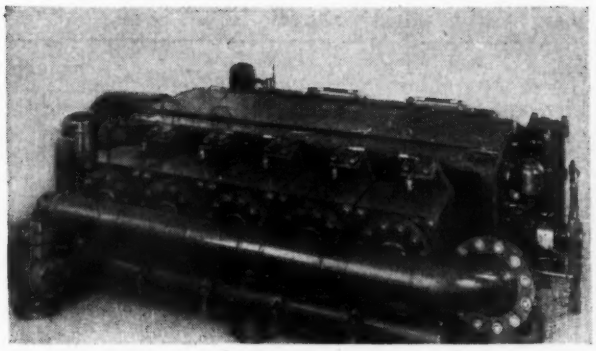

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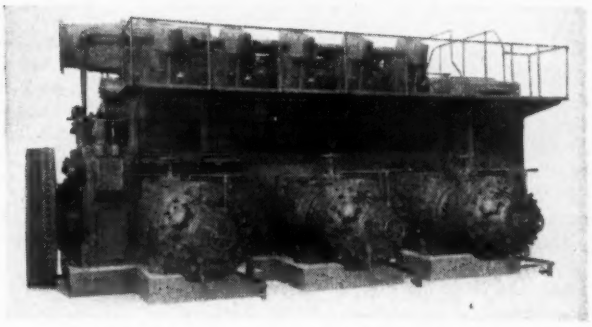

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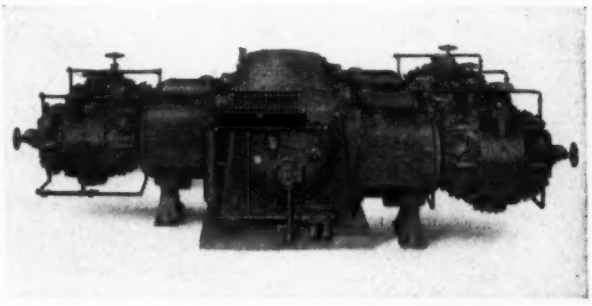

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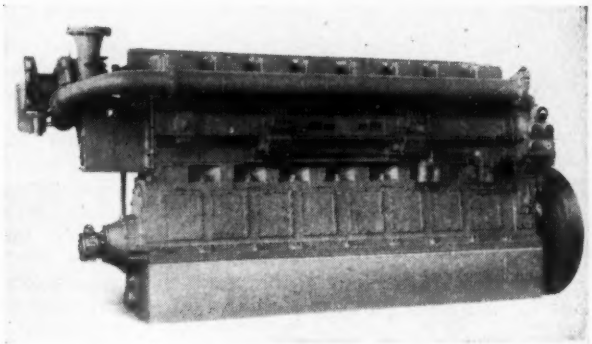

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Under "type of valve," provision often is made to show manufacturer's catalog number, plant number, cost of valve, etc.

Some plants "tag" the valve in various ways to show service, unit on which installed, and specified lubricant. Such valves always should be tagged when sent to the maintenance shop.

The Standard Plug Valve

Essentially, any plug valve consists of a tapered plug with a central hole and a body; the body has a tapered hole to take the plug and a longitudinal hole through which the fluid passes under control of the plug. The standard type of valve, such as shown in Fig. 1, has a cover to retain the plug and packing to stop leaks around the operating shank. Crude bronze valves, basically similar to present-day plug valves, were found in the ruins of Pompeii. It is known that wooden ones, made from a hollow log and carrying a tapered plug, were in use when the Pyramids of Egypt were built. Very few fundamental changes occurred in their design until 1918, except for materials of construction.

The modern standard type of lubricated plug valve, Fig. 1, had its inception in the invention in 1918 by Sven Nordstrom of a means of introducing a plastic lubricant under high pressure throughout the closely-confined areas between the plug and valve body. This called for a central hole in the top of the plug communicating with a system of grooves and ultimately a lubricant chamber beneath the plug, pressure being applied to the lubricant either by jackscrew or grease gun. Its function, based on Pascal's law, "pressure applied to a confined fluid is transmitted uniformly to all areas of the confining surfaces", is to lift the plug slightly from its seat, thus freeing it and permitting lubricant to flow over the bearing surfaces of plug and body.

In the valve of Fig. 1, the plug compresses the packing while coming out of its seat during lubrication. Resilience of the packing is depended upon to re-seat the plug when hydraulic pressure exerted by the jackscrew or lubricant gun is relieved.

It is readily apparent, therefore, that the proper thickness and type of packing should be in the valve at all times if it is to operate properly. Likewise, the packing gland must be sufficiently tight to prevent leaks. It also must be snug enough to return the plug to its proper position when the hydraulic pressure from lubricating has been dissipated.

Metal dimensions change with temperature and this will affect the tightness of the packing gland. Hence packing glands should be inspected regularly and frequently—at least once a month—especially when seasonal changes occur. It never should be possible to turn a packing gland by hand, although field inspections often reveal this condition. Likewise, it should never be possible to turn a valve by "flopping" the wrench over the 90° operating arc. The firm pull which should be necessary is the usual gauge (aside from absence of leaking) of proper adjustment of the packing gland.

The packing used in these types of plug valves consists of an asbestos composition plus a synthetic packing ring, which gives all the compressibility needed when the service pressure and temperature ratings for the valve are not exceeded. It is made in standard sizes, available in complete sets from manufacturers and very easily installed.

Most standard types of valves having packing glands integral with the covers have cast iron bodies and forged steel covers. They will perform satisfactorily at pressures* up to 175 psi., handling water, oil or gas. They should not be used on refrigerated fluids below normal atmospheric temperatures or in excess of 125° F.

Intermediate Plug Valve

Construction of the "intermediate" type of plug valve, a typical make being illustrated in Fig. 2, is similar to the standard and lubrication is identical. The major change involves the packing gland, which is of screw or bolted construction separate from the cover. This is necessary because of the higher pressure ratings for this type.

Most manufacturers make this type of valve of cast iron and cast steel, recommending working pressures not exceeding 800 psi. The iron valve should not be used below atmospheric temperatures or above 150° F. The steel valve is good for the temperature range minus 50 to plus 250°, although some valve experts prefer a safer maximum of 225° F. Essentially the same maintenance recommendations as previously given for the standard valve apply to the "intermediate" type. The most notable addition applies to the bolted type of packing gland usually encountered in sizes above 4-in. It is essential for smooth operation of this type of intermediate valve that the several packing gland bolts be under equal tension. If they are not drawn down evenly, one bolt will carry the most stress and "bind" the plug. A difficult-to-operate valve and worn body or plug results; there is a strong tendency to over-lubricate in an attempt to free the plug, and the valve may be broken or damaged.

High-Pressure Plug Valves

There are several patented designs of high-pressure lubricated plug valves. The design illustrated in Fig. 3 is rated for pressures ranging from 150 lb. A.S.A.* to 10,000 psi. W.O.G.** and temperatures from minus 150° to plus 1000° F.

The high-pressure design illustrated is distinguished from the others previously described by the insertion of a "floating" plug through the bottom of the body casting and elimination of a mechanical packing gland. The method of sealing against external leakage involves injection of an asbestos fiber packing through a ball-check into the body of the valve, thus forcing it into an annular groove provided around the threaded operating stem. This permits repacking while the valve is in service. Operating stem and plug are connected by a yoke, called an "equalizing ring", to eliminate pressure thrust on the plug. The plug operates on a steel bearing; seating pressure is externally adjustable.

The plug is pushed downward from its seat by the hydraulic pressure exerted on top during lubrication instead of the lifting action occurring in the types previously discussed. The bottom assembly, or cover, is a calibrated thickness of boiler plate and holds the plug in its seat. During lubrication, when the plug is jacked from its seat, the bottom cover assembly flexes approximately 0.002-0.003-in. and its resiliency reseats the plug when the hydraulic pressure is relieved.

This arrangement relegates the packing to the status of sealer around the valve-stem and eliminates the factor of packing resiliency loss from high service temperatures. The metal diaphragm seals the bottom of the valve but does not support the plug in its seat.

Minimum Adjustment Required

In this design of valve a minimum of adjustment is required as there are no packing gland nuts to become loosened by reason of packing wear or from temperature changes. Adjustment of the plug in its seat is accomplished by means of the adjusting screw in the bottom cover of the valve. Service reports indicate this is rarely necessary but, as in the previous types of plug valves, the stem should never turn by "flopping" the operating wrench and the plug should seat tightly enough to afford a positive shut-off when the valve is in the closed position.

Lubrication is accomplished as in previously described valves and the same frequency requirements apply. In addition, plastic stem packing should be applied as often as necessary and the packing screw taken-up as required to prevent leaks.

* American Standards Assn.

** Water, oil or gas.

WITHIN THIS IMPREGNABLE VALVE...

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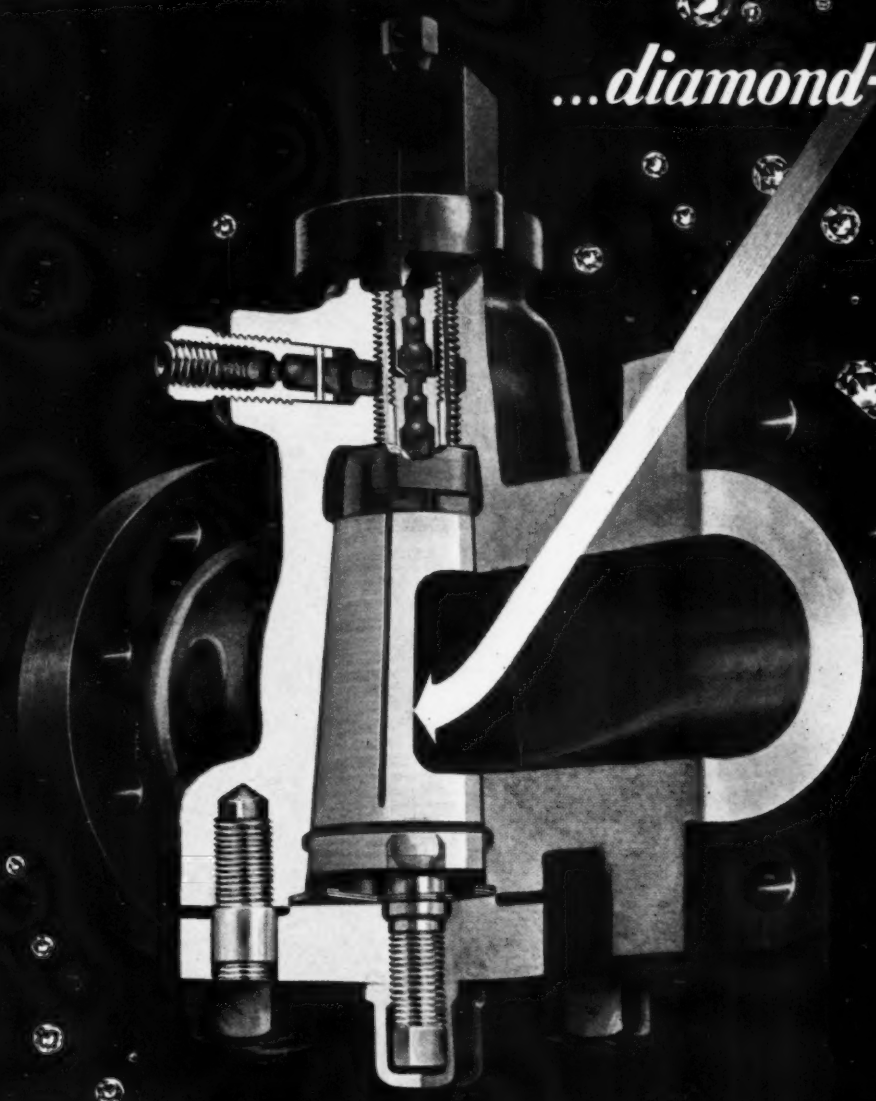

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Picturing NORDSTROM valves *in diversified applications*

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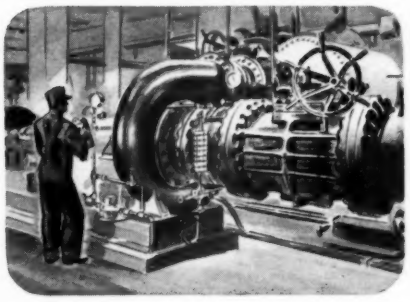
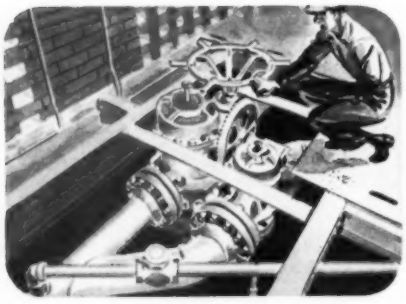
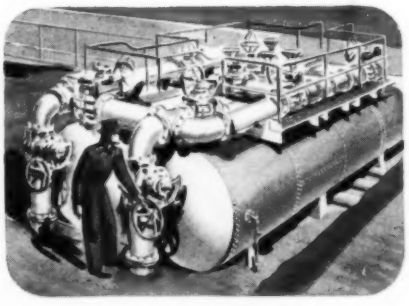


BUTANE PUMP—This huge volume pump delivers butane in a large refinery. Equipped with a 24″ Nordstrom valve on suction and a 20″ Nordstrom valve on discharge.

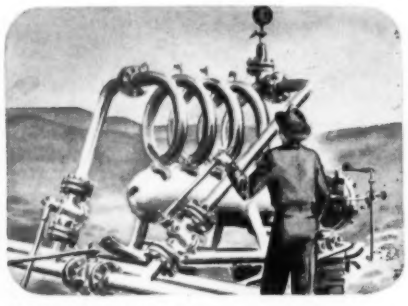


GASOLINE LINES—Nordstrom 6″ Hypreseal valves operating in combination on gasoline and furnace oil lines of Detroit Southern Pipe Line Co.

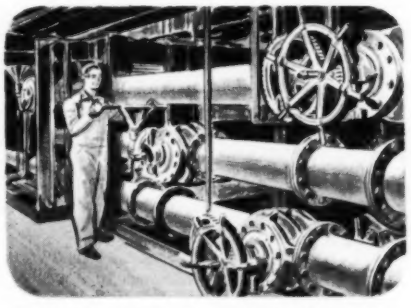


ARTIFICIAL GAS HOLDERS—High-pressure holders equipped with 12″ Nordstrom gear operated valves. Manifold is placed on top of tank for compactness.

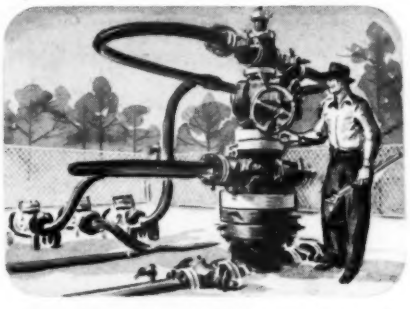
WATER LINE—To prevent back-flow of water into well, Continental Oil Company, at Westlake, Louisiana, uses a Nordstrom valve as a shut-off.



GAS TRAP—A high-pressure Mid-west gas trap on gas line carrying 1100 lbs. pressure, equipped with Nordstrom Hypreseals.



CHEMICAL LINES—On main chlorine lines in a liquefaction unit of a $100,000,000 plant, Nordstroms give perfect service.



CHRISTMAS TREE—A hook-up at Lake Creek, Texas, on lease of Superior Oil Co., producing from 3 zones through Nordstroms.

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Patent Trends in Petroleum Refining

By PETER J. GAYLOR

Patent Attorney and Editor "The Technical Survey"

Conversion Catalysts

CATALYTIC cracking now is gradually displacing thermal and the new techniques developed are being applied to other allied operations, such as catalytic reforming, dehydrogenation, etc. Since the heart of the process is the catalyst itself, considerable research is in progress on the production of better catalytic materials.

One patent (U. S. 2,432,746), issued to Filtrol Corporation, discusses the manufacture of an *ammonia clay* having superior properties. It points out that during acid treatment of a montmorillonite (Cheto) clay, the first 3-4% of the alumina removed gives the largest amplification of adsorptive and catalytic efficiency, since these properties do not proceed in step with the degree of extraction. As the extraction continues, the efficiency passes through a maximum, and when the R_2O_3 content is reduced to below 10-12%, the efficiency falls off and the treated clay has the activity of the raw untreated clay.

In practice, a sulfuric acid strength of 12-15% is ordinarily used with an amount of acid equal to about 30-50 lbs. acid/lb. volatile-free clay. Extraction temperature is about 180-210° F. and extraction time 6-9 hrs. The washed clay possesses residual titratable acidity.

According to the patent, this washed acid clay may be further activated by ammoniation of the clay. The washed clay is treated with ammonium hydroxide which reacts with the free sulfuric acid and the aluminum sulfate and other sulfates to form ammonium sulfate and hydrated alumina, etc. The ammonia also enters the clay structure by base exchange with the hydrogen of the montmorillonite and thus forms an ammonium clay.

When subjected to temperatures of 900°-1200° F, this clay loses substantially all of its ammonia. Any residual ammonium sulfate is decomposed and the base exchange ammonia is removed, apparently, to yield a hydrogen clay. In actual use for catalytic cracking, the ammoniated clays are first heated to drive off the ammonia.

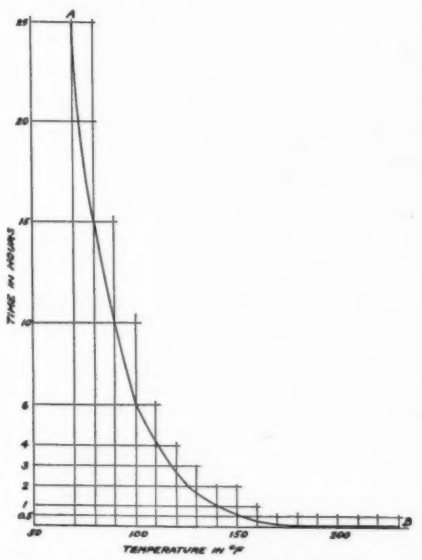


Fig. 1—Time-temperature chart for ageing hydrogel in the preparation of a new catalyst by Houdry Process Corp. (U. S. 2,433,869)

Another patent, issued to Houdry Process Corporation, (U. S. 2,433,869) deals with the production of *molded contact masses of high strength from synthetic gel materials.* The forming of shaped gel particles has presented a problem, since the gelatinous precipitates are ill-suited for molding operations for a number of reasons. They shrink greatly while drying and they become abrasive and readily wear away the parts in the molding machines.

According to the patent, hard low-density pellets, highly stable to deactivation, with steam, are produced by preparing a plural inorganic hydrogel containing a hydrous oxide of silica, and ageing the hydrogel in freshly prepared state without intermediate treatment following its preparation and at a temperature of at least 70° F. for a time of at least 5 min., the temperature and time being correlated to lie above and to the right of the line AB in Fig. 1. This appears to be an essential feature of the invention. When produced under these conditions, catalytic gels are obtained which are relatively stable and extremely hard.

Thereafter, the aged hydrogel is rapidly dried, pulverized, washed and treated to remove alkali metal salts, filtered, and again dried. The dried gel is finally formed into a paste with addition of water, cast into pellets, dried and calcined.

Table I shows the various conditions of treating the gel and the characteristics of the catalyst obtained. In the production of the catalyst, the gel was aged as disclosed above in order to provide for fast and economical drying.

TABLE 1—Treating Conditions and Catalyst Characteristics

Aging Conditions		Apparent	Hardness,	Activity	Stability	
Hours	Temp., ° F.	Density	Grams	Per Cent Gaso.	Hardness	Activity Per Cent Gaso.
24	70	.62	2,400	49.3	2,700	34.9
48	70	.64	7,100	47.3	6,100	33.8
0.5	175	.58	6,600	45.6	6,800	33.2

Isomerization Technique

CONVERSION of n-butane to isobutane is normally accomplished with an aluminum chloride or bromide catalyst in presence of a hydrogen halide such as hydrogen chloride as activator. Conversion rates are usually low in a continuous process unless the capacity of the reaction vessel is considerable. To overcome this disadvantage, a porous supporting material is usually incorporated with the catalyst to increase catalyst surface.

In its U. S. Patent 2,428,841, Anglo-Iranian Oil Co. has obtained still better results by inserting an adsorptive material such as alumina or silica gel in the stream behind the reactor, preferably at lower temperature than the reactor, for adsorbing and entraining active catalyst which otherwise would be destroyed or reduced in value. By this means, high conversion rates may be achieved at relatively low temperatures, thereby avoiding by-product formation encountered at higher temperature, while utilizing only a small amount of catalyst.

Fig. 2 depicts a flowsheet illustrating the technique employed. Normal butane from storage (a) is first preheated at (g) and led into reactor (b^2) where it meets a stream of catalyst fed in from storage (f). The reactor is preferably at 75-125° C. Bed (b^2) may consist of lumps of aluminum chloride in a perforated container. Below this is a bed (b^1)

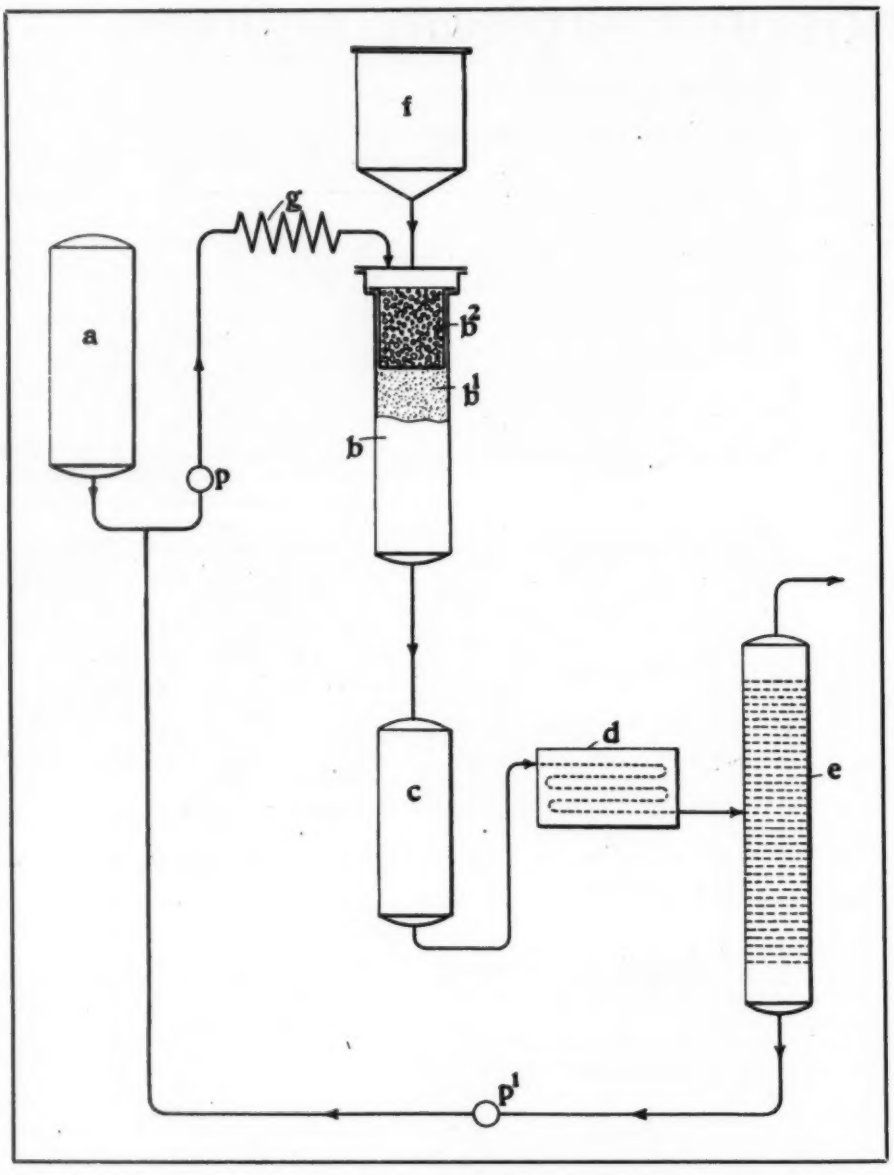


Fig. 2—Flow diagram of improved isomerization process technique patented by Anglo-Iranian Oil Co. U. S. 2,428,841

of alumina. In vessel (c) is another bed of alumina maintained at low temperature which serves to entrain catalyst leaving vessel (b).

Thereafter, the product is passed through condenser (d) and fractionated in tower (e), the n-butane being recirculated to the feed line.

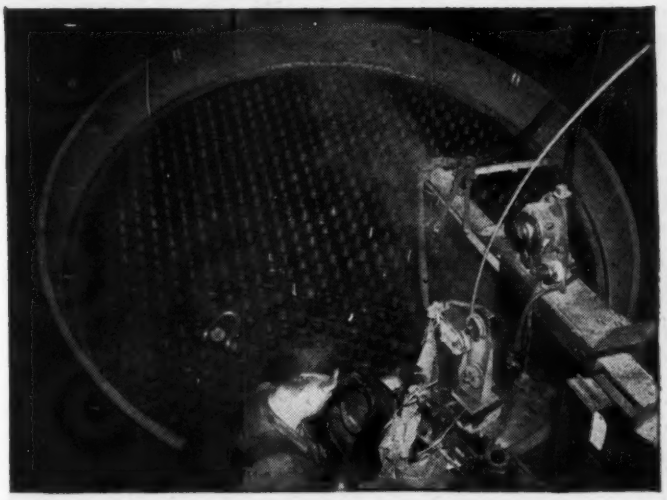
The claim covers a continuous process for the production of branched chain alkanes from normal alkanes by providing an isomerization reaction vessel having a bed of solid aluminum halide in its upper portion and a bed of solid adsorptive medium of high available surface area adjacent thereto, said adsorption bed being maintained at a relatively low isomerization reaction temperature at least equal to the temperature of the bed of solid aluminum halide, flowing a feedstock comprised of a normal alkane and a small proportion of hydrogen halide downwardly through said vessel over the material of the beds, and flowing fresh additional solid aluminum halide onto the bed of aluminum halide as the supply of solid aluminum halide is consumed and requires replenishing.

Patents of the Month

U.S. 2,433,072 & 255 (Texas Co.)—Reaction between CO and hydrogen.
U.S. 2,433,243 (Gulf Oil)—Diesel fuel oil preventing ring sticking, etc.
U.S. 2,433,286 (Union Oil)—Extractive distillation.
U.S. 2,433,306 (Sinclair Refg.) — Dehydrating nitriles.
U.S. 2,433,316 (Amer. Cyan.) — Alkaryl sulfonate wetting agent.
U.S. 2,433,345 (Houdry Process)—Cyclic catalytic process.
U.S. 2,433,363-5 (Southern Wood Preserving Co.)—Reforming Hydrocarbons to induce toxicity to wood destroying fungi.
U.S. 2,433,395 (Standard Oil Co. Ind.)—Oxygenated sulfur compounds.
U.S. 2,433,396 (Standard Oil Co. Ind.) — Sulfuric acids.
U.S. 2,433,426 (Floridin Co.) — Desulfurizing adsorbent.
U.S. 2,433,465 (Atlantic Refg.) — Separating olefin from diolefin.
U.S. 2,433,482 (Standard Oil Ind.)—Preventing build-up of light gases in paraffin isomerization.
U.S. 2,433,572 (Gulf Res. & Dev.)—Corrosion preventives.
U.S. 2,433,603 (Calif. Research) — Catalytic conversion.
U.S. 2,433,646 (Sun Oil)—Soluble oil.
U.S. 2,433,716 (Gulf Oil)—Diesel fuel oil.
U.S. 2,433,718 (Gulf Res. & Dev.)—Determining location of producing horizons.
U.S. 2,433,726 (Universal Oil Products)—Contacting fluids with subdivided solids.
U.S. 2,433,797 (Texas)—Lubricating oil.
U.S. 2,433,798 (Standard Oil Ind.)—Catalytic conversion.
U.S. 2,433,800 (Universal Oil Products)— Butadiene.
U.S. 2,433,851-2 (Standard Oil Development) —Pour depressants.
U.S. 2,433,853 (Lubri-Zol)—Sulfurized oils.
U.S. 2,433,861 (Standard Oil Development) — Anhydrous high temperature reversible grease.
U.S. 2,433,869 (Houdry Process) — Hard, low density catalyst pellets.
U.S. 2,433,876 (U.S.A.)—Polyisobutylene coated materials resistant to mustard gas.
U.S. 2,433,932 & 43 (Aerojet Engrg.)— Nitromethane fuel composition.
U.S. 2,433,944 (Standard Oil Development) — Continuous alkylation.
U.S. 2,434,000 (Phillips Petr.)—Converting butane mixture into higher boiling paraffins.
U.S. 2,434,095 (Pure Oil) — Removing thiophenols from phenols.
U.S. 2,434,098 (Stanolind Oil & Gas)—Density indicating apparatus.
U.S. 2,434,110 (Shell Dev.) — 2-Methyl propanol-3-al.
U.S. 2,434,202 (Socony Vacuum) — Contacting gases with particle form solid contacting materials.
U.S. 2,434,394 (Shell Dev.)—Unsaturated alcohols.
U.S. 2,434,403 (Phillips Petr.) — Cyclopentadiene.
U.S. 2,434,424 (Shell Dev.) — Extractive distillation with inverse solvents.
U.S. 2,434,437 (Shell Dev.)—Isomerization.
U.S. 2,434,490 (Standard Oil Development) — Rust preventive lube oils.
U.S. 2,434,537 (Standard Oil Development)—2-Stage hydrocarbon synthesis.
U.S. 2,434,634 (Sun Oil)—Isomerizing 1-olefins to 2-olefins and cracking.
U.S. 2,434,650-1 (Standard Oil Development)— Amine-containing motor fuel.
U.S. 2,434,683 (Shell Development) — Surface-active compositions.
U.S. 2,434,796 (Phillips Petr.)—Extractive distillation of C_4 hydrocarbons with furfural.
U.S. 2,434,815 (Union Oil)—Oil from oil shale.
U.S. 2,434,833 (Atlantic Refg.) — Alkylating aromatics with sulfuric acid-silica gel.
U.S. 2,434,888 (Shell Dev.) — HBr catalyzed oxidation.
U.S. 2,434,923 (Phillips Petr.) — Distilling butadiene from methyl acetylene, etc.
U.S. 2,435,038 & 087 (Gulf Res. & Dev.)— Catalytic dealkylation of alkyl aromatic compounds.
U.S. 2,435,124 (Shell Dev.) — Dispersing a foam-reducing silicon-containing compound.
U.S. 2,434,623 (Socony Vacuum) — Simultaneous alkylation and desulfurization.
Can. Pat. 445,514 (Shell Dev.) — Aromatic nitrogen-containing hydroxy compounds.
Can. Pat. 445,515-7 (Shell Dev.) — 2,3,5 and 2,3,6 trimethyl phenols and 3,5 dimethyl phenol (from isophorone).
Can. Pat. 445,519 (Standard Oil Development) —Breaking water-in-oil emulsions.
Brit. Pat. 595,406 (Yorkshire Tar Distillers)— Separation of phenols from hydrocarbon distillates.
Brit. Pat. 595,502 (Shell Dev.)—Polyallyl alcohols.
Can. Pat. 445,644-6 (Shell Dev.)—Alkyl phenol purification.
Brit. Pat. 595,037 (Anglo-Iranian) — Dehydrogenation and hydrofining of naphthas.
Brit. Pat. 595,055 (Standard Oil Development) —Catalytic conversion.
Brit. Pat. 595,706 (Anglo Iranian Oil) — Isomerization.
Brit. Pat. 595,721 (Shell Dev.) — Polymerizing methyl pentadienes.
Brit. Pat. 595,742 (Shell Dev.)—Catalytic conversion.
Can. Pat. 445,780 (Shell Dev.)—Acetone dehydration.
Can. Pat. 445,781 (Shell Dev.)—Diacetyl from MEK.
Can. Pat. 445,782 (Shell Dev.) — Cyclopentanone by oxidizing cyclopentane.

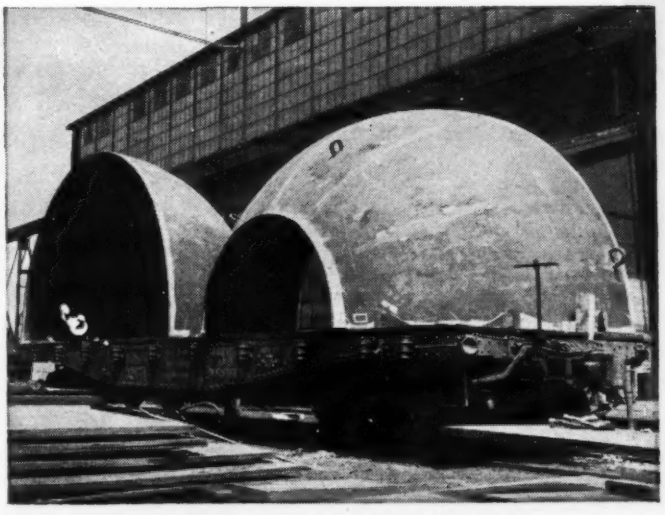
Solving new problems in pressure vessels...

AN OLD STORY AT B&W



Stress Problem Solved

Installing 753 tubes and 4½ in. tube sheet in huge converter for operation over wide range of temperatures, is typical of difficult stress problems solved by B&W.



Field Construction Simplified

Short-cuts in fabricating 100 ft. x 20 ft. catalyst reactor in B&W shops saved erection time on location.

Designing and fabricating pressure vessels, drums, tanks, towers, tubes, piping and related products is a major activity at B&W — and has been for many years. Here, practical solutions for new problems encountered in the application of high-pressure, high-temperature equipment are constantly being developed. In fact, B&W has pioneered many pressure vessel fabrication techniques such as fusion welding, x-ray inspection, stress relieving, welded drums and streamlined openings. Any requirement in pressure vessels can be brought to B&W with confidence of getting sound engineering and the benefits of most advanced fabricating methods.

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Scalloped Type Wall Saves Metal In Construction of Storage Tanks

CONSIDERABLE REDUCTION in the thickness of metal in the wall sections of oil storage tanks can be obtained by an improved design for the fabrication of the horizontal courses.

As shown in one form of the invention in Fig. 1, the tank 10 comprises a sheet metal shell in the form of a large number of circular segments 12, made up of individual sheet metal plates arranged in the usual horizontal courses or rows. Each segment is placed with its concave side facing toward the interior of the tank.

The required strength is provided by inwardly projecting metal flaps, or diaphragms, 16, at the intersection of each segment 12, along with tie members 18 connecting the various diaphragms. Tie members 18 may be sheet metal, rods, bars, or the like.

A modified form, preferred for floating roof type tanks, is designed with the diaphragms 16 projecting outside the tank wall and tie members 18 connected across the outside, or convex, face of each segment.

Another modification uses the new design for the lower several courses in the tank and then reverts to conventional construction above that point. Use of this latter design in a 400,000 bbl. capacity tank, 40 ft. in height by 268 ft. in diameter, was reported to reduce the wall thickness in the lower, scalloped sections by about 50%.

U. S. 2,433,335, issued Dec. 30, 1947, to Harry C. Boardman, assignor to Chicago Bridge & Iron Co.

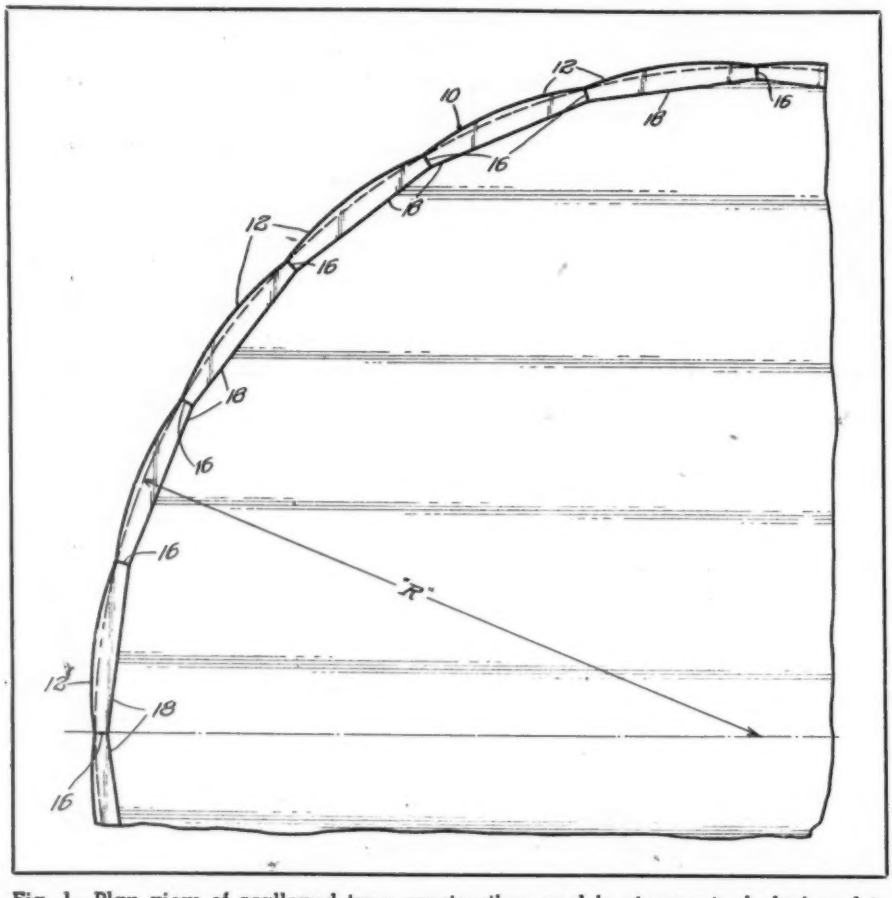


Fig. 1—Plan view of scalloped type construction used in storage tank designed to reduce wall metal thickness (U. S. 2,433,335)

Chain Type Cutting Tool Useful For Wide Range of Pipe Sizes

REMOVABLE LINKS in a chain-type pipe cutting tool make it useful for a wide range of pipe sizes down to three inches in diameter. As shown in Fig. 2 it is being employed on an approximately 12 in. pipe.

It consists of a series of arc-shaped links 9, joined to form a chain for wrapping around the pipe to be cut. At each linkage point, a small roller 25 is provided which rests against the pipe. A central tapering rib around the periphery of each roller follows the kerf made by the cutter and prevents traveling of the chain lengthwise of the pipe.

Adjustments on the tension of the chain are made by the threaded handles 19 which also serve as means to revolve the tool in its cutting movement around the pipe. If preferred, a cutting wheel can be substituted for one of the rollers, thus eliminating the need for the cutter assembly 12.

U. S. 2,433,606, issued Dec. 30, 1947, to John B. Gill and Leonard C. Schomer, assignors to Pilot Mfg. Co., San Francisco, Calif.

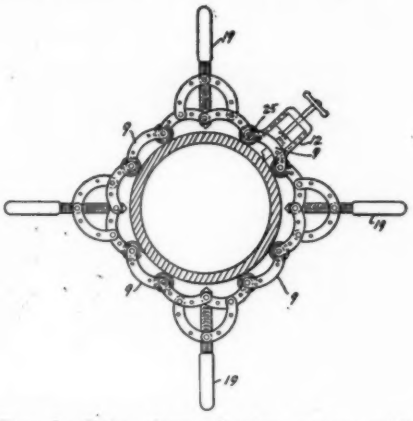


Fig. 2—Side view of pipe cutter with large number of links arranged around a pipe of relatively large diameter (U. S. 2,433,060)

Magnetic Tool Finds "Go-devils" Jammed Inside Buried Pipelines

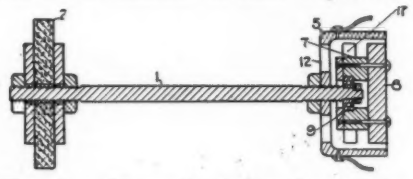


Fig. 3 — Magnetic device for locating lost, jammed pipeline go-devils (U. S. 2,428,326)

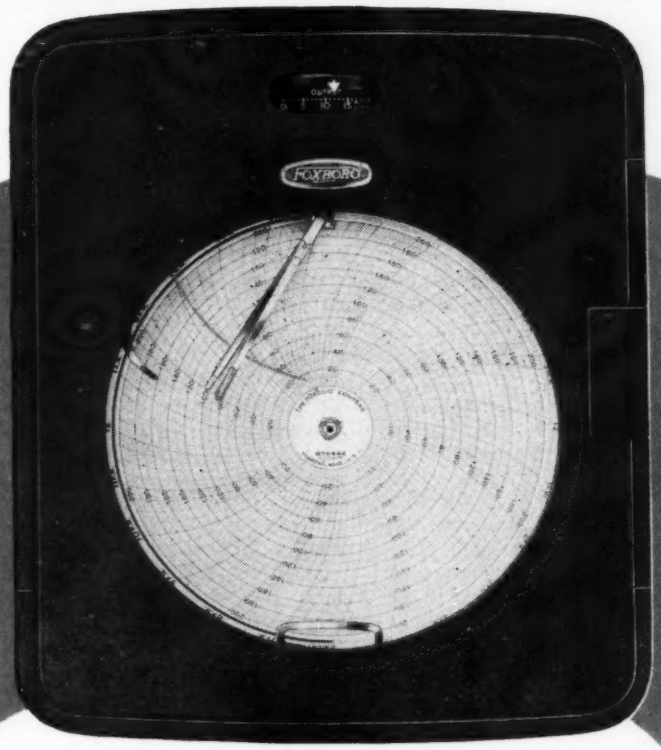
A MAGNETIC DEVICE has been adapted to locating jammed scrapers or go-devils in buried pipe lines. It is said to eliminate the method of digging "bellholes" at various intervals and listening for the motion of a second scraper which has been run in to locate the jammed tool, which method is only partially satisfactory.

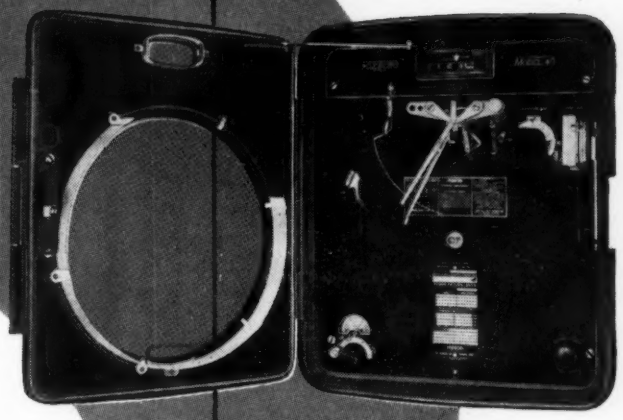
The new locator is illustrated in Fig. 3. Mounted on one end of a frame member 1 is a conventional piston 2. At the other end a housing 5 holds a turbine 7, which is mounted on ball bearings 9 on shaft 1. Attached to the turbine is a bar magnet 8, preferably made of a steel alloy with high magnetic retentivity properties.

In operation, the unit is run into the pipeline by fluid flow exerting

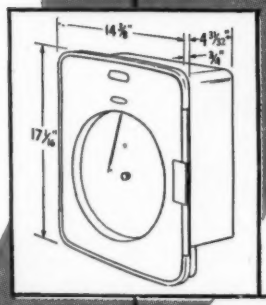
An Ideal Case

FOR THE ADVANCED ENGINEERING FEATURES OF *M-40* CONTROLLERS





Manual Control Subpanel is *inside* the case — saving ⅓ or more of valuable panel area.



Check these dimensions. The Foxboro Model 40 is the most compact recording controller available.

Streamlined and rugged, the Model 40 Case assures the greatest operating life for controller mechanisms, and the greatest flexibility in unit combinations. Yet it is also the most *compact* controller case available. Even the manual control panel is enclosed — saving panel space and installation time.

This new case is of cast aluminum, with all parts resistant to corrosion. Special design keeps dust out when flush door is opened. New compression door gasketing keeps gas and moisture out. New hinge permits removal of door without tools or removal of case from panel. New cam-type latch is extra strong, positive in action, flush with door. The five-coat enamel finish is hand-rubbed and infra-red baked for durability and appearance.

This improved case is just one of the reasons why the Foxboro Model 40 is the most-wanted pneumatic controller ever developed — why *more than 6000 units have already been delivered!* Write for Bulletin 381. **The Foxboro Company, 246 Neponset Ave., Foxboro, Mass., U. S. A.**

CHECK THESE FEATURES TOO

- Permaligned Construction
- Simplified Adjustments
- Interchangeable Units
- Wide-range Variable Reset and Derivative Resistances
- Simplified Control Relay — overload protected
- 4-Position, "Bumpless" Transfer Switch
- Exclusive Ball Linkage
- Complete range of control types and functions

FOXBORO
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M-40 CONTROLLER

THE ONLY CONTROLLER WITH *Permaligned* CONSTRUCTION

pressure against piston 2. When its motion is stopped by the jammed go-devil, the piston 2 is deflected by the continuing fluid flow. The resultant flow through ports 12 in the housing 5 strikes blades 17, turning the turbine and magnet. This sets up an electromagnetic field around the pipe which can then be picked up by any suitable detection device on the ground above.

U. S. 2,428,326, issued Sept. 30, to Charles H. Fay, assignor to Shell Development Co., San Francisco.

Use Electrically-Heated Bellows In Rapid Response Valve Design

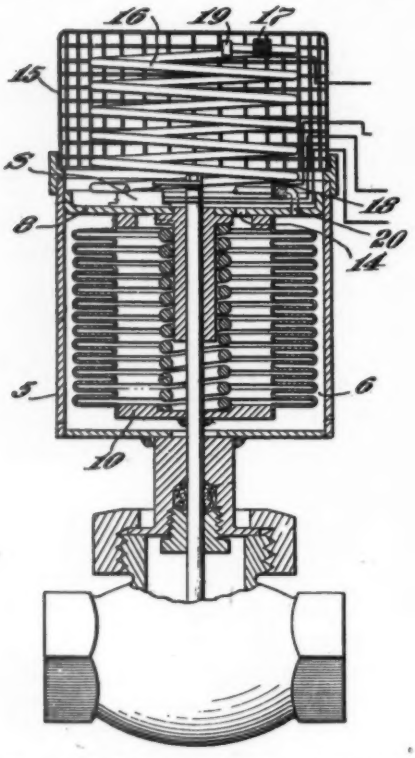

Fig. 4—Boiler coil 16 in electrically heated, bellows-operated valve reduces time lags encountered ordinarily in remote control valves (U. S. 2,433,493)

AN ELECTRICALLY heated bellows, motor-operated valve is said to function with a minimum of lag regardless of outside conditions. One form is illustrated schematically in the partial cross section in Fig. 4.

The valve itself is operated by a conventional pressure motor comprising a fluid-tight casing 5. Movement of the movable head 10 corresponds to increases and decreases in the effective size of the motor chamber 6.

The interior of the bellows diaphragm communicates with the outside atmosphere through passage 14 in wall 8. A protective cage 15 of woven wire or perforated metal is mounted upon casing 5 and houses a boiler 16, consisting of a helical coil of small diameter tubing. This tubing is made of an electrically-resistant material which will become highly heated by the passage of current.

End portions of the coil 16 are mounted in insulating supports 17 and 18, and the upper end is enclosed by a cap 19 while the lower end communicates with chamber 6 through tube 20. The ends are also connected to the secondary circuit of a step-down transformer.

The boiler coil and the chamber are first evacuated and then filled with a substance which will expand very rapidly when heated; for example, methyl chloride, alcohol, or ether.

In operation: when a switch in the transformer primary circuit is closed, the boiler coil is quickly heated, producing pressure in chamber 6 due to expanding liquid and/or vapors within, and tending to collapse the bellows and lift the valve stem. When the switch is opened, the boiler coil cools off quickly, because of its large external area and small mass. The fluid in it contracts rapidly permitting the valve stem to move down again.

U. S. 2,433,493, issued Dec. 30, 1947, to Jacob L. Turner, assignor to Manning, Maxwell & Moore, Inc., New York, N. Y.

Ledge on Internal Insulation Serves as Catalyst-Bed Support

AN ADVANTAGE CLAIMED for an improved construction method for a multi-bed catalyst chamber is the use of a projecting ledge of the internal insulation to support each catalyst bed instead of using a metal support attached to the steel shell.

This was possible through the use of an insulating material with sufficient strength to resist the shearing forces of the weight of the catalyst material.

The refractory material from which the insulation is constructed consists of a mixture of the following compounds in the approximate proportions indicated:

Compound	Wt.-%
Silica	50.61
Alumina	31.06
Ferric oxide	3.76
Ferrous oxide	2.73
Calcium oxide	10.08
Titanium oxide	1.94

The mixture is mixed with water in the proportions suitable for the correct consistency needed for application, just as with any cement-type refractory. The lining, after application, sets by drying in the conventional manner.

U. S. 2,431,803, issued December 2, 1947, to Jesse A. Guyer and Lawrence G. Molique, assignors to Phillips Petroleum Co., Bartlesville, Okla.

Other Recent Patents

Space does not permit the complete review of all patents issued recently on equipment for the petroleum processing industry. Following, however, are brief abstracts of those with greatest interest:

Liquid Level Controller is based on a responsive capacity change device which controls a vacuum tube oscillator circuit that can be remotely located with respect to the responsive device. U. S. 2,433,599; Dec. 30, 1947; Theodore A. Cohen, assignor to Wheelco Instruments, Co., Chicago, Ill.

Fixed Bed Catalytic Apparatus for dehydrogenation or aromatization of hydrocarbon gases uses simplified design to reduce the costly and elaborate piping and valving said to be found in conventional equipment. U. S. 2,433,670; Dec. 30, 1947; Einar Kropp, assignor to Standard Oil Co. (Ohio), Cleveland, Ohio.

Fluid Catalytic Cracking Apparatus provides for more efficient control of flow conditions to the required value, somewhat above the critical velocity. A feature of the design is the compact construction and elimination of external transfer lines. U. S. 2,433,726; Dec. 30, 1947; Charles H. Angell, assignor to Universal Oil Products Co., Chicago.

Fluid Catalytic Cracking Apparatus employs a series of grids within the the reaction chamber to prevent channeling and uncontrolled turbulence of the catalyst and oil vapors by redistribution through uniform openings. It also provides for breaking up of the undesirable agglomerates occasionally formed by powdered catalysts. U. S. 2,433,798; Dec. 30, 1947; Vanderveer Voorhees, assignor to Standard Oil Co. (Ind.), Chicago.

Leakproof Pipe Joint Seal fits over entire circumference of a pair of flanged connections and is made of a band of strip steel. It is adjustable to various sizes of pipe by means of a clamping mechanism similar to a trousers belt buckle. Metal band is lined on one face with a suitable sealing or gasketing material. U. S. 2,434,878; Jan. 20, 1948; Benjamin N. Williams; Glenham, N. Y.

How to Obtain Patents

Readers may obtain copies of any U. S. patents from the Patent Office at 25 cents each. Order by patent number from: The Commissioner of Patents, Washington 25, D. C.

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That's what you're most likely to see on any refinery piping layout. To piping men, the main reason at least is obvious. There is no better, no more dependable quality than Crane.

Add to that the unmatched completeness of the Crane line. Everything for the job is at your finger tips when you reach for the Crane Catalog. It's the easy way to simplify every piping installation . . . from design to erection to maintenance. For when you specify Crane throughout, you include this 3-way advantage:

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2. **ONE RESPONSIBILITY** for piping materials—helping you to get the best installations, and to avoid needless delays on jobs.
3. **OUTSTANDING QUALITY IN EVERY ITEM** assures uniform durability and dependability in pipping systems from end to end.

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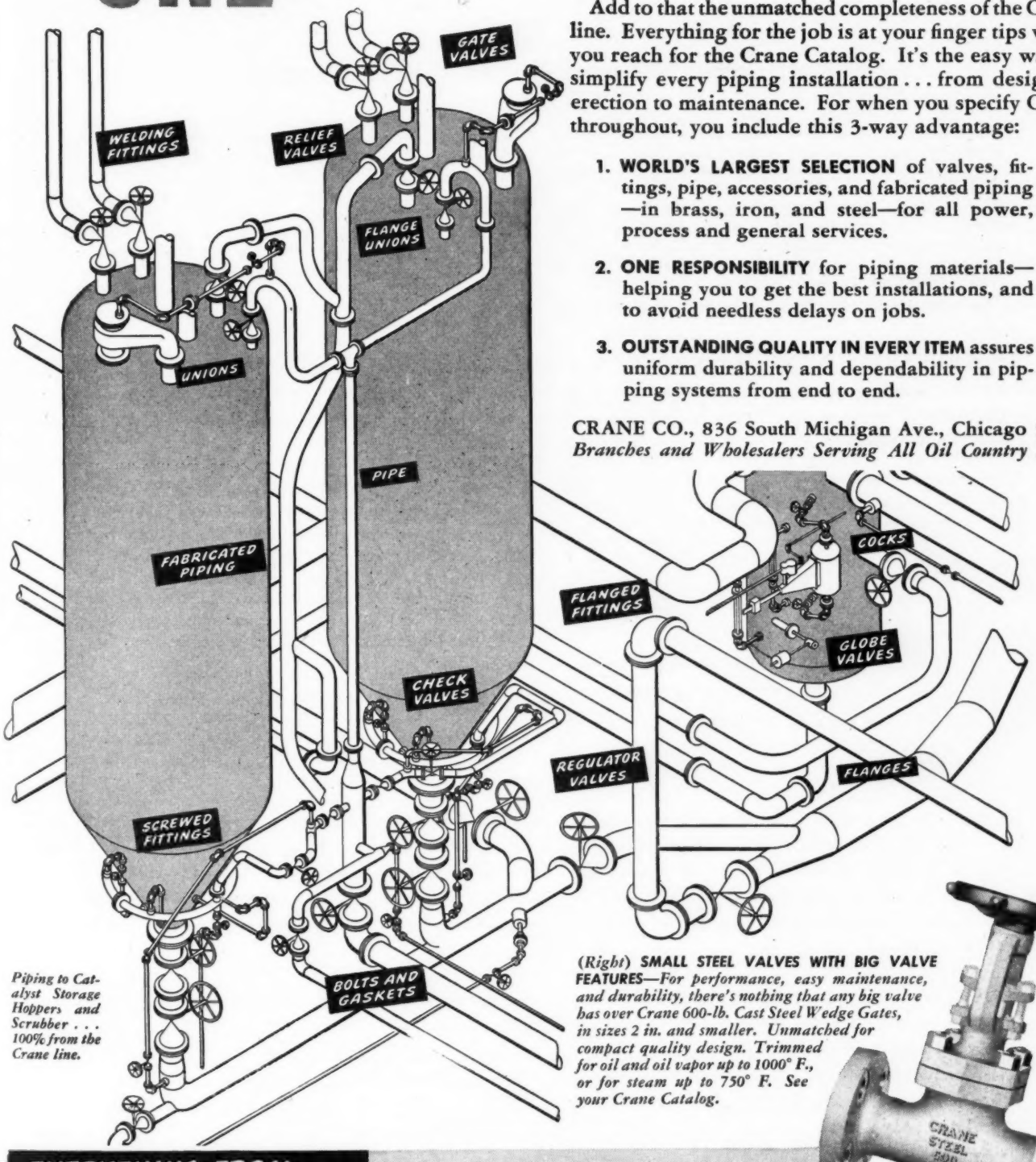

Piping to Catalyst Storage Hoppers and Scrubber . . . 100% from the Crane line.

(Right) **SMALL STEEL VALVES WITH BIG VALVE FEATURES**—*For performance, easy maintenance, and durability, there's nothing that any big valve has over Crane 600-lb. Cast Steel Wedge Gates, in sizes 2 in. and smaller. Unmatched for compact quality design. Trimmed for oil and oil vapor up to 1000° F., or for steam up to 750° F. See your Crane Catalog.*

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"INDUSTRIAL WASTE DISPOSAL

for

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Disposing of industrial wastes is a never-ending problem—yet there has been a surprising lack of up-to-date information and authoritative reference data on this important subject.

For that reason, "INDUSTRIAL WASTE DISPOSAL" is a book that fills a real need and will be welcomed by all engineers and technicians who are concerned with effective, economical control and disposal of harmful wastes.

The author—W. B. Hart—is a widely recognized and highly respected authority in this field, having been actively engaged in solving the problems of industrial waste disposal for the past 20 years. Mr. Hart is a graduate of the University of Pennsylvania with the degree of Doctor of Pharmacy. With Atlantic Refining Company since 1923, he has charge of waste disposal for his Company, and is Chairman of the Committee on Disposal of Refinery Wastes of the American Petroleum Institute.

"INDUSTRIAL WASTE DISPOSAL" is a complete treatise, starting with a brief review of the economic and legislative backgrounds; then a full discussion of the kinds of industrial wastes and their harmful effects; and right on through the "how" of proper waste disposal.

There is a wealth of reference information and operating facts in this book; over 100 pages (8½ x 11) of material, presented clearly and logically under these main divisions . . . .

ECONOMIC and LEGISLATIVE ASPECTS

KINDS OF WASTES

EFFECTS OF INDUSTRIAL WASTES

PRELIMINARY INVESTIGATIONS

TREATMENT OF OIL-CONTAINING WASTES

The text of "INDUSTRIAL WASTE DISPOSAL" was first published as a series of articles in Petroleum Processing magazine, intended primarily for refinery engineers; however, a large part of the material is so basic that it is applicable to all kinds of waste control—whether in a refinery, a dairy, a tannery or other type of industrial plant.

Methods for determining, measuring and controlling industrial wastes are covered in a thorough and wholly practical way, with appropriate sketches and diagrams.

For the man who works directly on industrial waste control, this new book is a valuable 'on-the-desk' ready reference; and it is a useful addition to the general library of all plants having a waste control problem. Finding quick answers to specific problems is facilitated by a detailed index; and the bibliography of 174 references is a real help when it is necessary to dig fully into the details of a particular phase of the general waste disposal problem.

"INDUSTRIAL WASTE DISPOSAL" is the most complete and up-to-date book on this important subject . . . 68 detailed illustrations, 11 tables, 103 pages, 8½ x 11, attractively bound in stiff cloth covers, with the title stamped in gold on front cover and backbone . . . a convenient, practical desk reference and a valuable addition to any technical reference library, private or public . . . . $4.00. *Ohio purchasers, please add 3% sales tax.*

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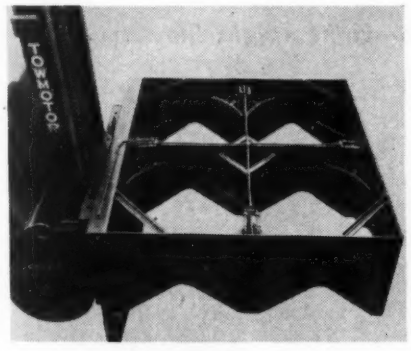
EQUIPMENT MATERIALS PROCESSES LITERATURE

What's New!

Reviewed by WILLIAM C. UHL, Equipment Editor

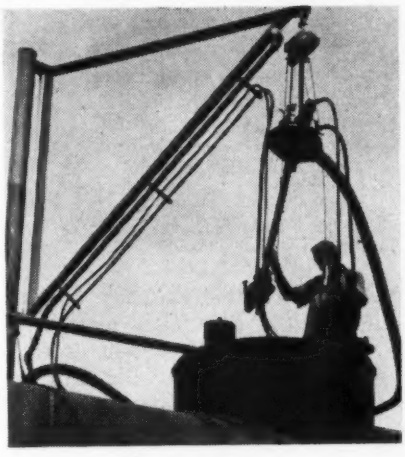
1—Four-drum Carrier

Designed for rapid installation on a standard industrial fork truck, the new Towmotor Multiple Drum Carrier will handle up to four standard size drums. Equipped with eight, hydraulically-actuated, gripping shoes —two in each of the four compartments, it can be used to lift, transport, and replace its load, and can stack drums three-high. Heavy steel, lower extension on rear bulkhead enables operator to push drums into position. Angular design on sidewalls then automatically places drums in gripping position if carrier is not directly over the load. Entire frame of carrier is of welded construction. Towmotor Corp.



2—Tank Car Cleaner

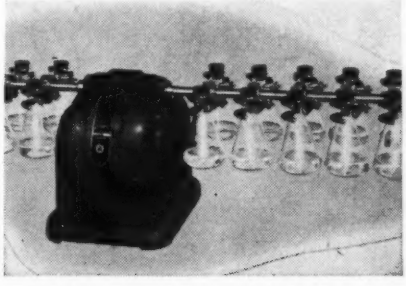
Complete, safe, and automatic cleaning of tank car interiors at the rate of 2 hrs. per car is claimed for the new Oakite Interior Tank Cleaning Unit, Model 324. It is said to be particularly useful for cars carrying gasoline, lube oils, crudes, or fuel oil. Odors can be removed without steaming. Constructed of brass castings and tubing, the unit consists of a top assembly fitted with securing bolts. Top of unit contains an air-operated motor that transmits power through reducing gears to bottom spray nozzle assembly. Nozzles revolve at 5 rpm vertically and 1 rev./hr. on a horizontal axis. In use, the unit is lowered into tank car dome



and clamped into place. Cleaning solution is delivered from a steam-heated tank at 100 psi. and 180° F. Hot and cold rinsing is an automatic follow-up. Oakite Products, Inc.

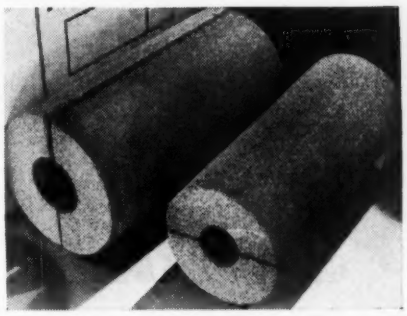
3—Wrist-action Shaker

Simulating the snap of the wrist as in shaking by hand, the "Wrist-Action" Shaker has accessory clamps to handle a wide variety of laboratory mixing operations. It will handle any size volumetric flask, standard round bottles up to four ounces, standard square bottles up to four ounces, Erlenmeyer flasks up to 2000 ml., Squibb separatory funnels up to 1000 ml., short neck, flat, or round bottom flasks up to 2000 ml., and test tubes up to 50 mm. in diameter. It is furnished in three sizes. The model shown will accommodate 24 Erlenmeyers at 250 ml. each. Burrell Technical Supply Co.



4—Foam Glass Insulation

Properly installed, the new Foamglas pipe insulation may be used for the temperature range of minus 200° to plus 800° F., it is reported. The material is supplied in two equal half-sections, 18 inches long, and for all sizes of pipe. Manufacturer states its cost is less than other type material, on an annual basis. It is non-combustible acting as a fire retardant, and is water and vapor proof. It is easily cut and fitted with ordinary tools. The thermal conductivity is the same whether the material is wet or dry. Pittsburgh Corning Corp.



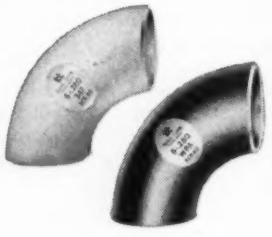
5—Hard Surface Electrode

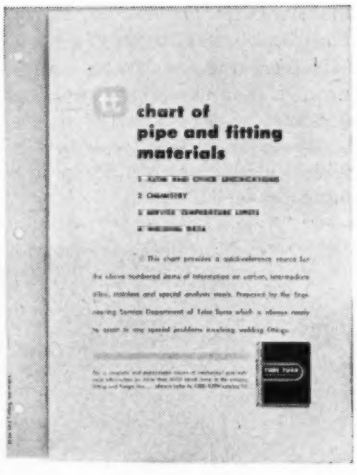
"Hartop" is a new line of hard-surfacing welding electrodes available in four models covering the Rockwell C range from 35 to 63 (as deposited). Hartop Brown provides 35 to 40 Rockwell C hardness and is for welds subject to angular shock and abrasion. Hartop Green with 45 to 50 hardness is for high resistance to impact and abrasion. It is designed for carbon and alloy steels, manganese steels, and cast iron. Hartop Red is for severe impact and abrasion; Rockwell C rating of 50 to 55. Hartop Yellow covers the range 58 to 63; its deposits resist abrasion and deformation caused by weight and impact. Harnischfeger Corp.

More "What's New!" Items, Page 266

WHAT'S THE DIFF?

in Pipe and Fitting Materials





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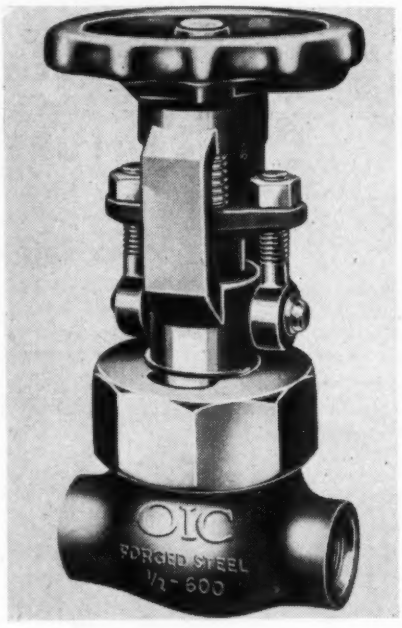
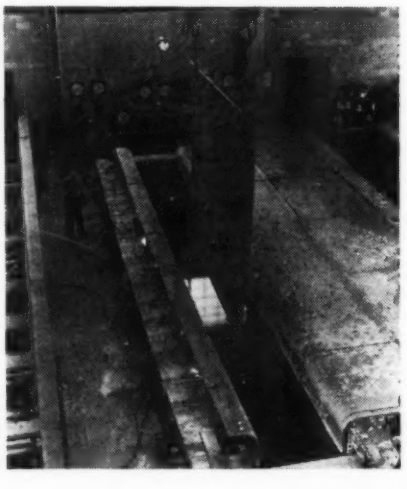
6—Forged Steel Valve



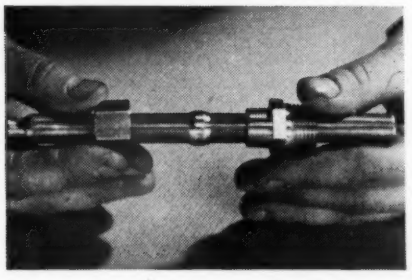
Removal of the packing without disturbing the flow is a feature of the new line of OIC 600-lb. Forged Steel Valves, because the mirror-finish on the mating back-seat surfaces is said to insure a leak-proof seal. The union bonnet ring is machined from rolled steel and is of octagonal design. Bonnet studs and nuts are heat-treated. Valves are available in all sizes. Ohio Injector Co.

7—Alloy Descaling

Clean, bright surfaces on Lukens alloy and alloy-clad steel products through thorough removal of metallic oxide films is expected with the recent installation of a new sodium hydride descaling unit at the company's mill in Coatesville, Pa. The equipment will be used on all metals not affected by molten caustic or by heating at 700° F. Savings in metal, more uniformly descaled surfaces, and shorter descaling time are claimed as the principal advantages offered by the new process over blast cleaning. Lukens Steel Co.

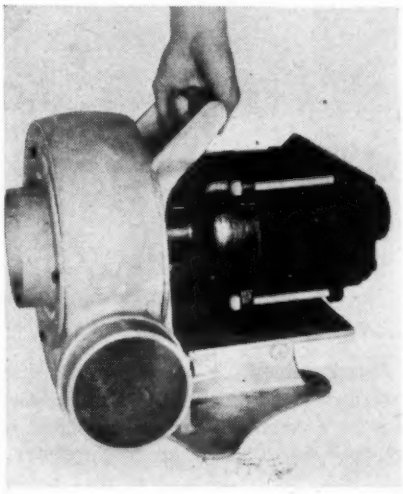


8—Thermometer Fittings



A new method for adapting compression type fittings to thermometer bulbs is said to enable users to change thermometers originally made with plain bulbs to union connections. Compression fittings are applied directly to the bulb to produce any desired length up to 6 inches. A separable socket may also be provided by welding or soldering a well to the union bushing. Manning, Maxwell & Moore, Inc.

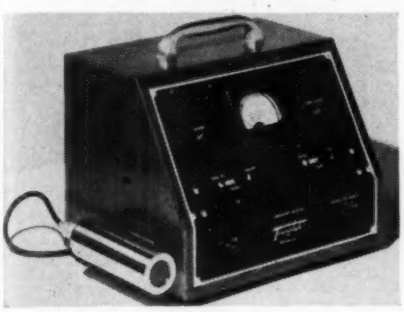
9—Light-weight Blower



Aluminum construction is said to give the new "SAF-T-AIR" portable safety ventilator its light weight. Electric motor-driven, the unit weighs 50 lbs. and has a capacity of 425 cfm. Balanced handle has been placed over the center of gravity. Its size permits it to pass through small openings and hard to get to places. The unit will operate on ordinary lighting circuit. United Electric Motor Co.

What's New!

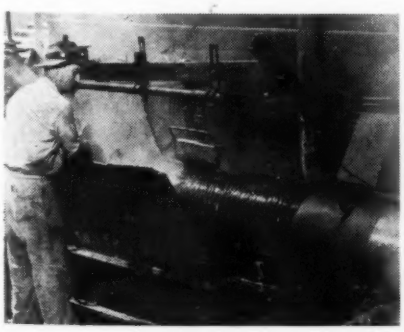
10—Radioactivity Safety



The Tracerlab Model SU-3 Laboratory Monitor has been developed specifically for use as a routine contamination monitor in radioactive laboratories. It is a small, portable, AC operated, counting rate meter of moderate accuracy, with three full scale meter ranges of 200, 2000, and 20,000 counts/min. It is equipped with a thin mica window (3-4 mg./cm.^{2}) sensitive Geiger tube, enclosed in a probe connected to the instrument by a four ft. length of shielded cable. It is stated it will detect contamination from such very low energy Beta emitters as Carbon 14 or Sulfur 35. Power supply required is 110 to 125 volts, 60 cycles, input is 50 watts. Dimensions are: 9 by 12 in. panel, with maximum depth behind panel of 9 in. Net weight, including Geiger tube mounting is 17½ lbs. The instrument is calibrated to yield an accuracy of 5% of full scale on all ranges. Tracerlab, Inc.

11—Pipe Coating

"Duratex" pipe coating is said to provide high resistance to electrolysis and corrosion as well as shock impact resistance, valuable when a buried line is being back-filled. Its ductility will withstand severe earth shock and movement, and it will not "slump" or "creep". A flash and fire point in excess of 500° F., as well as non-toxicity, provide for safety during application. National Petroleum Sales, Inc.

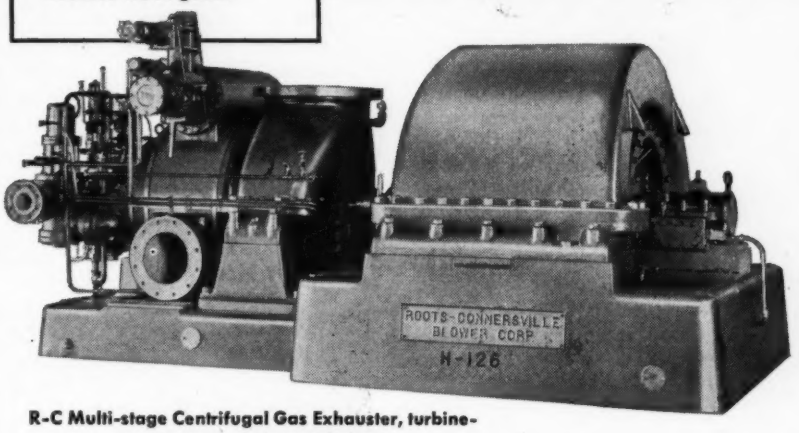


More "What's New!" Items, Page 268

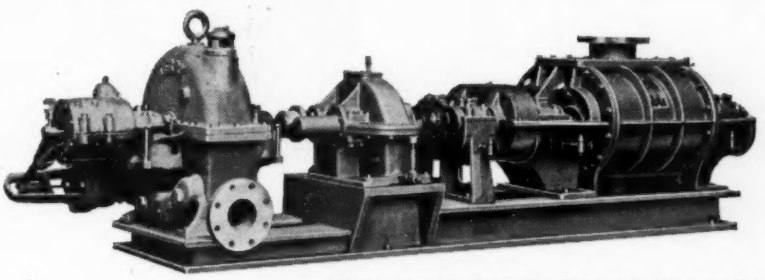
Oil was first produced by drilling in 1859, five years after the first Roots Blower was built. We're not good because we're old, but old because we're good.

NO "HEDGING" ON BLOWER QUESTIONS FROM

R-C dual-ability



R-C Multi-stage Centrifugal Gas Exhauster, turbine-driven. Capacity 20,000 CFM.



R-C Rotary Positive Gas Exhauster for oil refinery service. Capacity 750 CFM.

When you ask Roots-Connersville engineers about blowers, exhausters or gas pumps for refinery or petroleum processing applications, you'll get unbiased answers, without "hedging" between Centrifugal or Rotary Positive equipment.

That's because of our *dual-ability* to design and build both types. We recommend whichever is best suited to the specific application. We are the only blower builders offering you this important *dual choice* . . . an advantage which usually saves time, money and trouble.

You'll obtain outstanding performance from R-C equipment, too . . . the result of 94 years of experience plus the advanced thinking of alert engineers and designers.

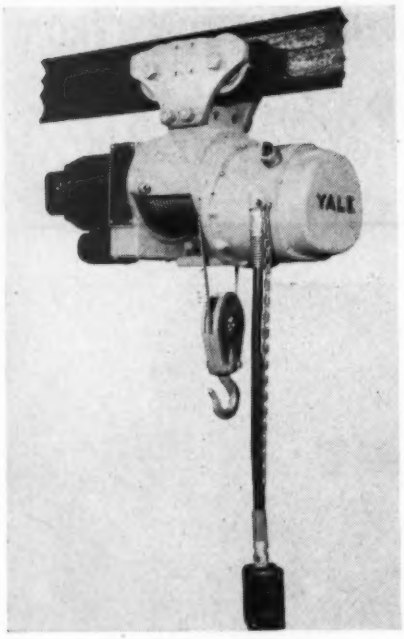
So, for any problem of moving or measuring gas or air—consult R-C *dual-ability*.

ROOTS-CONNERSVILLE BLOWER CORPORATION
803 Texas Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE
ROTARY CENTRIFUGAL
BLOWER BUILDERS R-C SINCE 1854
BLOWERS • EXHAUSTERS • BOOSTERS • LIQUID AND VACUUM PUMPS • METERS • INERT GAS GENERATORS

★ ★ ONE OF THE DRESSER INDUSTRIES ★ ★

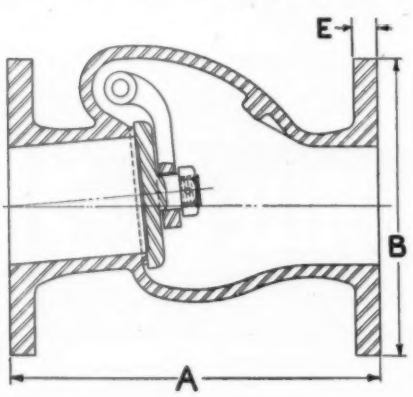
12—Low-capacity Hoist



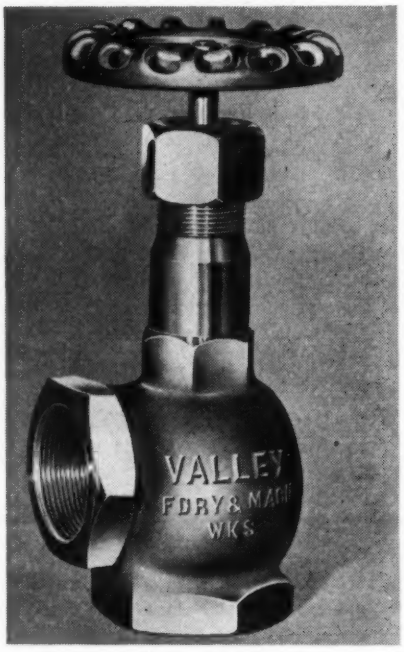
The "Load King" line of light duty, electric, wire rope hoists is said to provide low cost in the capacity range ¼, ½, and 1-ton. The frame is a one-piece, ribbed-steel casting, constructed for use with lug, swivel hook, plain or motor trolley, or winch-type mountings. Six standard models use ¼ to 1 hp., AC or DC motors, and provide 10 ft. lift. Additional lift length can be supplied. Hoist speeds range from 12 to 35 ft./minute on 60 cycle current. For 25 or 50 cycle current, speeds are reduced approximately 15%. Gross weight of all models between 180 and 190 lbs. Units are equipped with large-diameter drum with machine-cut grooves for guiding cable. Yale & Towne Mfg. Co.

13—Swing Check Valve

Designed primarily for the chemical processing industry, the new Cooper stainless steel swing check valve is suitable for any application where horizontal or vertical operation is required, the manufacturer states. The body is in one piece, eliminating bonnet flanges and gaskets. A long hinge pin supports the disc, and is in turn supported on both ends by accurately machined plugs. Hinge pin can be removed from either side of body by removing one plug only. Valves can be furnished with outside levers and weights for manual or automatic control. It is available in various alloys —18-8—S, 18-8—SMO, FA-20, and others. Sizes ½ to 3 in., screwed Fig. #201 for 300 psi. service; and ½ to 6 in., flanged Fig. #200 for 150 psi. service. Cooper Alloy Foundry Co.



14—Stainless Angle Valve



Pressure can be applied in closing without turning the valve in the seat, thus eliminating cutting or abrasive action, in a new stainless steel angle valve. Said to have application in the chemical processing industry, the Valley valve is made of 18-8 Mo, type 316 alloy, and is available in 1½, 2, and 3 in. sizes. Renewable valve seat of neoprene, hard rubber or fiber can be supplied. Valley Foundry & Machine Works, Inc.

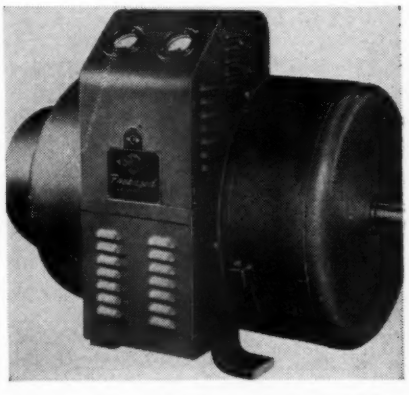
15—Laboratory Flowmeter

A new Laboratory Kit flow meter, the "C-Clamp Flowrator," is designed to meet the varied flow measurement requirements of research or control laboratories. It consists of a metering tube holder with base plate and

hose connectors, four interchangeable tubes, six metering floats, and calibration data. Capacities covered are from 0.065 to 2200 cc./min. of water, and from 5.0 to 36,800 cc./min. of air. For high-pressure applications, the same "set" is available in an enclosed model for safety. Fischer & Porter Co.

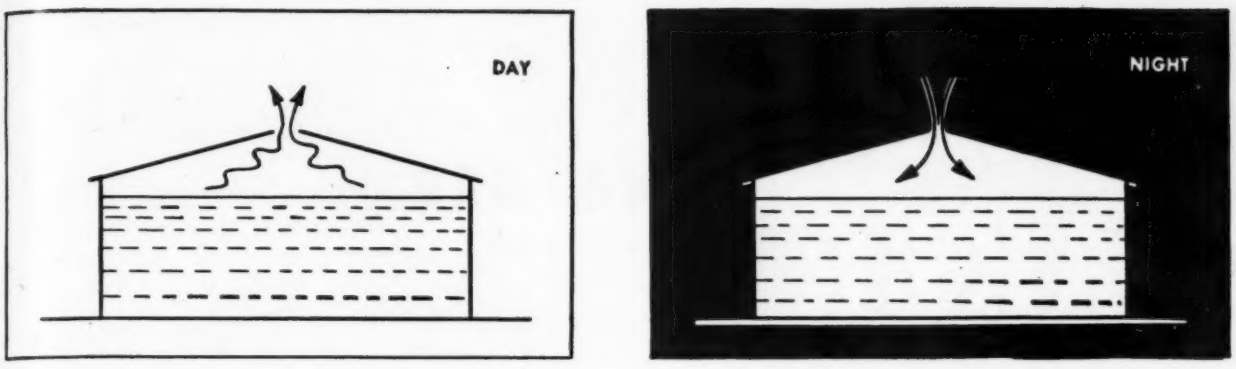
16—Packaged Generator

The principle of electrical resonance is used to hold terminal voltage within 2% of the value selected in the new "Packaged" AC Generator, at any load or power factor within the generator rating, according to the manufacturer. The automatic voltage regulating circuit has no moving parts and requires no maintenance. The only external connections needed on the unit are leads to a generator switch. 60-cycle ratings at standard voltages and 0.8 power factor include: 18.7, 25, and 31.3 kva at 1200 rpm; and 25, 31.3, and 37.5 kva at 1800 rpm. Electric Machinery Mfg. Co.



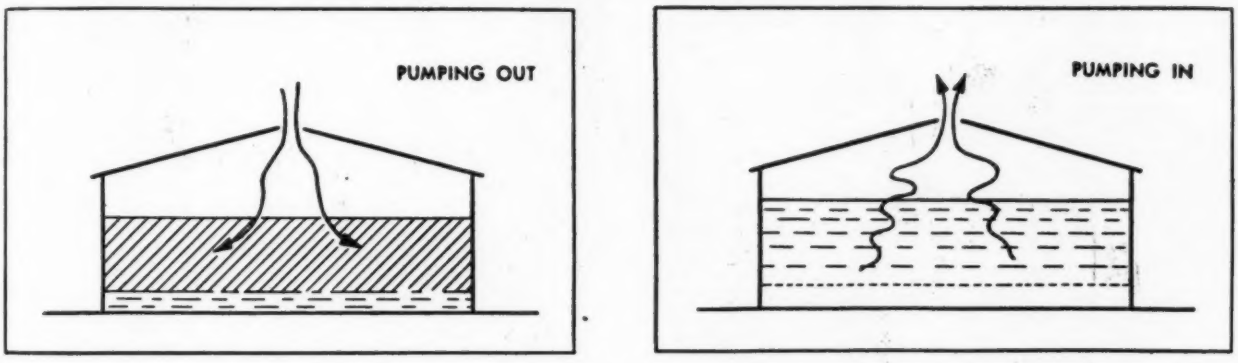
More "What's New!" Items, Page 271

STANDING LOSSES



Standing losses vary from 2 to 4 percent of the tank volume per year, depending on the tank size. In addition, the value of the gasoline is reduced through vapor venting.

PUMPING LOSSES



Pumping losses may be conservatively estimated at 0.16 percent of the liquid volume pumped.

THE SOLUTION

The Wiggins Hidek Floating Roof

Hermetically seals the liquid surface.

Permits a relatively small volume of vapor intentionally trapped beneath the roof to expand without venting.

Permits free vertical movement of the roof as it rises and falls with the oil surfaces during filling and emptying.

WIGGINS VAPOR SEALS
GENERAL AMERICAN
*TRADE MARK

General American
TRANSPORTATION CORPORATION

135 SOUTH LA SALLE STREET, CHICAGO 90, ILLINOIS

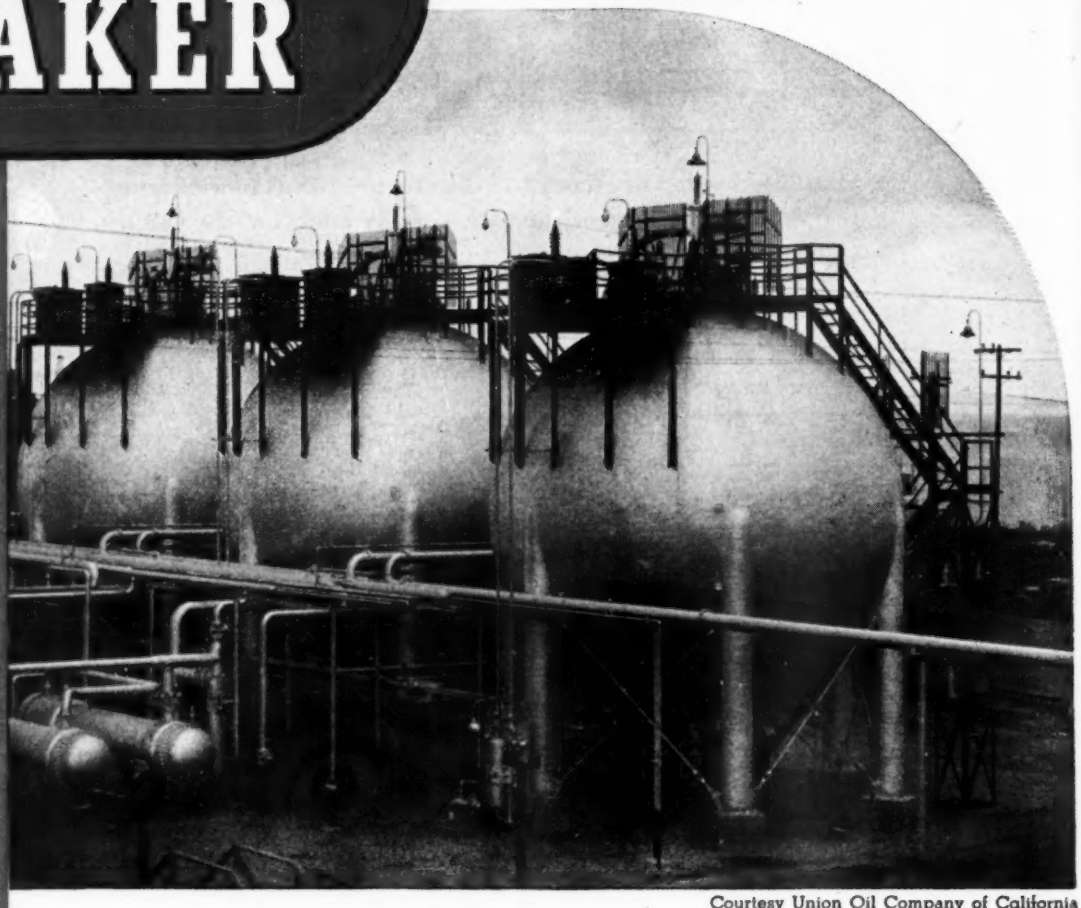
BRANCH OFFICES: New York • Washington, D. C. • Cleveland • Buffalo • Pittsburgh
St. Louis • New Orleans • Tulsa • Dallas • Houston • Seattle • Los Angeles • San Francisco

SUB-LICENSEES:

WESTERN STATES: Consolidated Steel Corp. — Western Pipe & Steel Co. of California, Los Angeles — San Francisco
SOUTHERN STATES: Wyatt Metal and Boiler Works, Houston — Dallas, Texas
FRANCE: Etablissements Delattre & Frouard reunis, Paris
CANADA: Toronto Iron Works, Ltd., Toronto

WIGGINS HIDEK FLOATING ROOF
WIGGINS BALLOON ROOF
WIGGINS BREATHER ROOF
WIGGINS DRY SEAL LIFTER ROOF
WIGGINS DRY SEAL GAS HOLDER

SALT SHAKER KING SIZE...



Courtesy Union Oil Company of California

A Petreco Electric Desalter doesn't exactly *shake* out the salt, but it sure gets rid of it–right now. Most Petreco desalters are getting 90% or better removal–98, 99 and 100% removal efficiencies are not unusual. Desalting eliminates the nuisance of frequent refining shut downs caused by salt plugging, hard coking and HCl corrosion. Desalting insures greater capacity, longer runs, and smoother operations. If you're having any salt difficulties, get in touch with us. We've helped some mighty good refining men shake the salt problem out of their hair. *The Petreco process is not expensive;* a Texas refiner recently figured his Petreco desalter paid off in less than six months. Get in touch with a Petreco engineer–he'll show you the figures!

PETROLEUM RECTIFYING COMPANY
5121 South Wayside Drive, Houston 1, Texas
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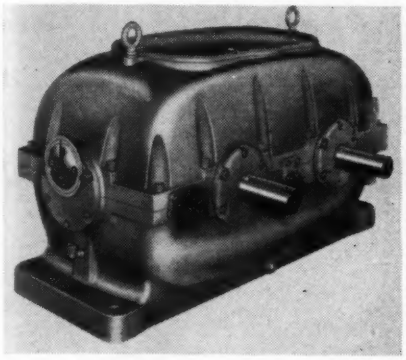
530 West Sixth Street, Los Angeles 14, Calif.

PR48-2

PETRECO

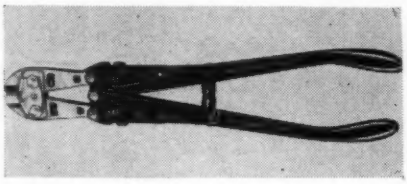
SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

17—Speed Changer



Using a link belt transmission with infinitely variable cones, the new, H-6 size, Link-Belt P.I.V. Gear Variable Speed Changer provides for ratings from 20 to 25 hp. It is rated at 20 hp. for speed ratios of 5-1 and 6-1, and at 25 hp. for ratios of 2-1, 3-1, and 4-1, with the constant speed shaft rotating at from 450 to 500 rpm. The changer is reported finding applications in chemical plant pumping as well as on general repair shop automatic machine tools. Measurements are 48½ in. overall length by 26¼ in. high and 36 in. wide, including standard length, shaft extensions. Link-Belt Co.

18—Hand Cutters



A total of 15 improvements are said to feature a new line of Porter Hand Power Cutters for cutting bolts, rods, cable, chain, wire, rivets, and the like. Among them are: curved toe-in handles to decrease armspread and wrist bend, broad rounded palm-fit grip, metal safety handle stop, and jaws marked to show capacity and type of metal safely cut. Various models provide for capacities from ¼ to ¾ in., sizes from 14 to 42 in. tool length, and for cutting materials up to a 300 brinell hardness. H. K. Porter, Inc.

19—Fire Hose

"Qua-flex" is a new light-weight, rubber-lined, cotton fire hose which tests have indicated will withstand pressures up to 300 psi. It is especially constructed to fold flat, making it adaptable for storage on racks originally designed for unlined linen hose. It is quickly dried out and is leak-proof upon initial injection of water. Qua-flex is furnished in 25, 50, 75, and 100 ft. lengths, and in diameters of 1½, 2, and 2½ in. Quaker Rubber Corp.

Trade Literature

20—Oil Industry Equipment

Equipment for the Oil Industry, Bulletin 25B6676, covers such products as motor controls, transformers, unit substations, blowers, compressors, and centrifugal pumps. Allis-Chalmers Mfg. Co.

21—Pressure Tables

Allowable Working Pressures, a booklet of pressure tables for Tube-Turn welding fittings in all sizes and weights, and all regularly manufactured materials; for oil and chemical processes, power, refrigeration, and hydraulic services. Tube-Turns, Inc.

More "What's New!" Items, Page 273

WHY NOT SIMPLIFY WITH—

SUPER-SILVERTOP?

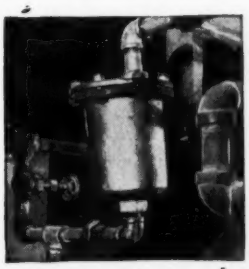
"Put a Super-Silvertop Steam Trap on that kettle! You'll be saving as many as 9 fittings and as much as 60 minutes of installation time!" Savings like that on each trap you install are "not to be sneezed at." Today fittings are hard enough to find for the places where they are really needed so why waste them?

Of course, there is more to choosing a steam trap than just how many fittings it takes. For instance, long service life, higher capacities, lower initial cost, neater installations—all these advantages and many more are reasons for installing only Super-Silvertop. Can we tell you more?

THE V. D. ANDERSON COMPANY
1974 W. 96th St. • Cleveland 2, Ohio

and here's how

Super-Silvertop showing one nipple and one union needed.



Conventional trap using seven fittings and two unions.

how to meet a big demand...

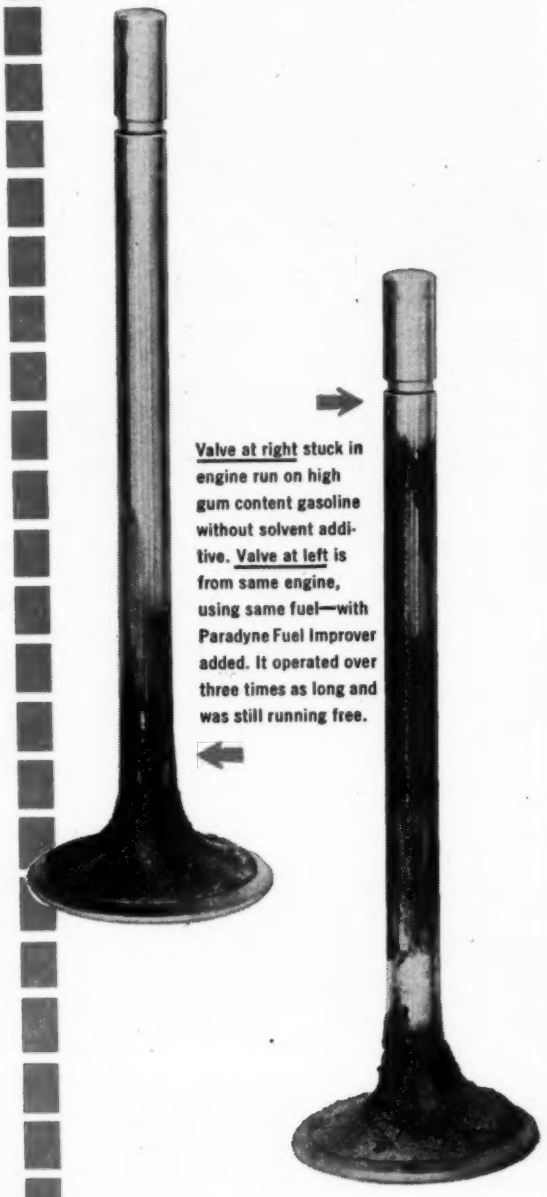
with your own brand!

RIGHT NOW! . . . there's a big market among motorists, truckers and farmers for a *good* gum solvent . . . an "upper lubricant" additive for gasolines that helps reduce valve sticking and wear, gives more power to sluggish motors!

AND RIGHT NOW! . . . you can get your share of this big and profitable market with PARADYNE Fuel Improver. It's rolling up profits for oil companies and auto accessory distributors . . . *and it's available for repackaging under your own brand name!* Write for Bulletin 101 and further details.

READ WHAT A MOTORIST WRITES ABOUT PARADYNE FUEL IMPROVER:

"I mixed Paradyne Fuel Improver with the gasoline in my '41 Buick (mileage: 76,000 — new rings installed at 30,000 mi.) and immediately noticed a decided improvement in its pick-up and pulling power on hills. The valves became freer and seemed to seat better. The motor also ran more smoothly and idled without missing."



Valve at right stuck in engine run on high gum content gasoline without solvent additive. Valve at left is from same engine, using same fuel—with Paradyne Fuel Improver added. It operated over three times as long and was still running free.

PARAMINS*

make good motor oils and fuels better!

ADDITIVES WITH A BACKGROUND

PARAMINS ADDITIVES ARE KNOWN BY THE BRANDS:

PARATONE —*for improved viscosity index.*
PARAFLOW —*for lower stable pour.*
PARATAC —*for tacky oils and greases.*
PARAPOID —*for E.P. gear oils.*
PARANOX —*for inhibiting corrosion and oxidation.*
PARASHEEN —*for better appearance.*
PARADYNE —*for improved gasoline.*

*Trade Mark

ENJAY COMPANY, INC.

15 WEST 51st STREET, NEW YORK 19, N. Y. • AGENTS AND DISTRIBUTORS THROUGHOUT THE WORLD

What's New!

22—Valve Capacity Calculator

Kontrol-Motor Valve Capacity Calculator is a circular slide-rule about 8 inches in diameter and is applicable to the K&M line of diaphragm valves and pressure regulators. Correction scales for steam quality, and liquid and gas specific gravity are included as well as a flowing temperature scale for gases. Kieley and Mueller, Inc.

23—Synthetic Chemicals

Sharples Synthetic Organic Chemicals, 15th edition, a 68-page booklet describing this line of products including alcohols, amines, ureas and amides, phenols, mercaptans and sulfides, alkyl chlorides, dithiocarbamic acid derivatives, and other hydrocarbons, with tables of physical properties, specifications, shipping practices, and other pertinent information. Sharples Chemicals, Inc.

24—Dew-point Control

Gasoline Absorption and Stripping Plants, Technical Bulletin No. 2225, a 24-page booklet describing a portable and automatic unit for the control of hydrocarbon dew-point of natural gas. A technical section reviews design calculations, summarizes vapor-liquid compositions for various operating conditions and includes vaporization graphs. Blaw-Knox Construction Co., Chemical Plants Division.

25—Petroleum Processing Index

Petroleum Processing Index for 1947 covers all special articles and stories as well as all regular departmental features for the 12 issues of last year. Classification is by subject and by author; it is completely cross-referenced for ease of use. National Petroleum Publishing Co.

26—Welding Accessories

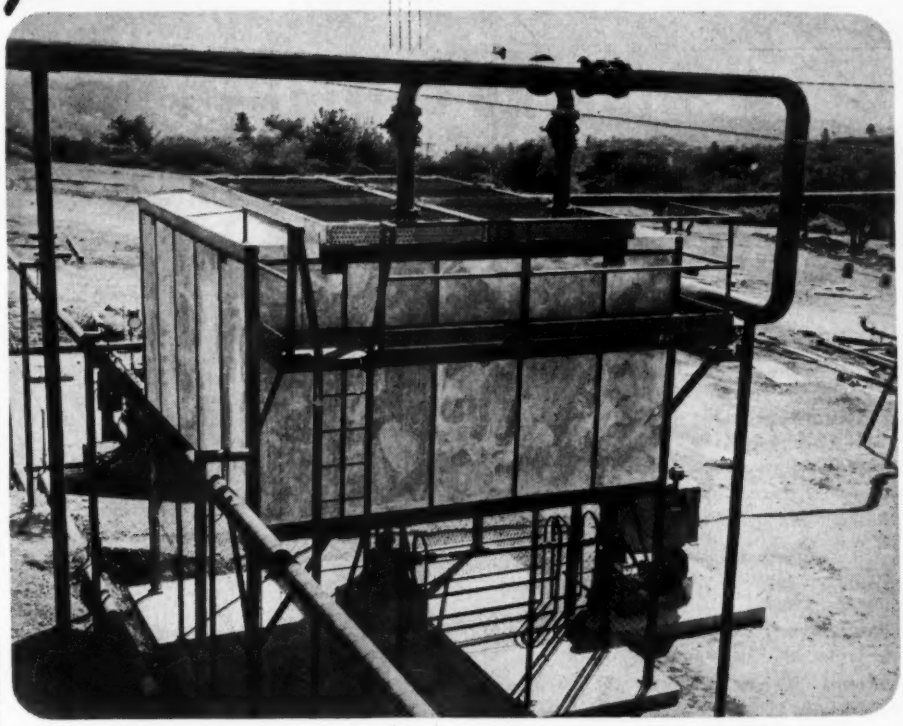
Twecolog, Form No. 1948-*T,* a 12-page catalog on welding electrode holders, ground clamps, cable connectors, terminals, splicers, lugs, etc. Includes price and parts information. Tweco Products Co.

27—Safe Centrifugal Pump

Ampco Centrifugal Pump, Bulletin 85, a 4-page pamphlet on a new line of pumps made of corrosion-resisting aluminum bronze for oil, water, acids, alkalis, and salts. Capacity ranges to 240 gpm and 170 ft. head. Close coupled and pedestal type; electric motor, turbine, or gas engine drive. Ampco Metal, Inc.

More "What's New!" Items, Page 274

Investigate **FIN-FAN**



the multi-service AIR-COOLED heat exchanger

The important advantages of the FIN-FAN Exchanger warrants its investigation for practically every condensing and cooling service. Note these features:

PROVEN WIDE ADAPTABILITY—highly successful operation under wide variety of duties—suitable for liquids, gases, and vapors at pressures up to 5,000 psi and temperatures up to 1500°F.

ECONOMICAL OPERATION–independent of wind velocity or direction . . . forced draft air circulation with highly efficient fans having power saving variable pitch blades, and uniform air distribution over K-Fin cooling sections.

EASE OF INSTALLATION, OPERATION AND MAINTENANCE— a complete, "package type" unit that can be installed on the ground or on top of buildings . . . no water supply equipment or piping . . . all mechanical equipment sturdy and readily accessible, with flexible operating control.

Write for complete information.

THE GRISCOM-RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus

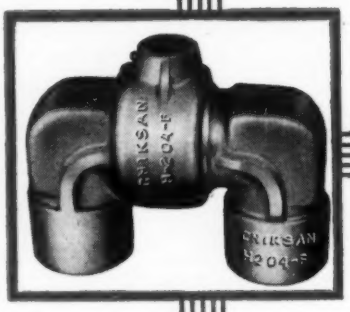
For a

WINNING COMBINATION

WHEREVER YOU USE FLEXIBLE LINES

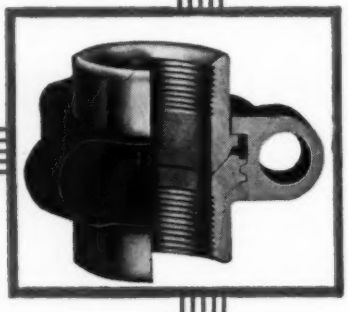
When you fit up swing lines, you want perfect flexibility with low torque, dependable unions and a lubricant that will prevent threads from rusting and freezing. You get all THREE of these advantages with the CHIKSAN-WECO Combination.

CHIKSAN Ball-Bearing Swivel Joints turn on double rows of ball bearings. That means smooth, easy action with low torque. There is nothing to tighten or adjust. That means low maintenance cost. CHIKSAN Packing Units are designed for many different services and pressures. That means dependable service.



CHIKSAN Ball-Bearing SWIVEL JOINTS

WECO WING UNIONS



WECO Wing Unions are made in a wide range of types and sizes for pressures to 12,000 psi. Thoroughly tested and widely accepted by the Petroleum Industry, under the most severe conditions, WECO Wing Unions are now available to users in all lines of industry.

WECO Thread Lubricants provide a perfect seal and complete protection against rust and corrosion. They do not harden under any conditions. Lines are easily set up or dismantled without injury to threads or fittings.

WECO THREAD LUBRICANTS

Representatives in all Principal Cities

WELL EQUIPMENT MFG. CORP. HOUSTON 1, TEXAS
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CHIKSAN TRADE MARK
BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES

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What's New!

28—Tube Cleaners

Wilson Tube Cleaners, Catalog No. 76, 48 pages on a complete line of tube cleaners for refineries, power plants, and chemical process plants. One section is devoted to special equipment made for specific jobs. Includes application data and specification tables. Thomas C. Wilson, Inc.

29—Heat Exchangers

K-Fin and G-Fin Heat Transfer Apparatus, Bulletin 1626, describes the services to which fin-type heat exchangers are adapted, including sectional drawings and photographs showing construction details of various condensers, heaters, coolers, and the like. Griscom-Russell Co.

30—Industrial Research

Partners in Research is the 32-page Annual Report, 1947, of the Armour Research Foundation of Illinois Institute of Technology. It covers brief reviews of most of the important projects being executed by the Foundation, including many of interest to the petroleum processing industry.

31—Process Control

Automatic Process Control, By Weight-By Volume, Bulletin 1560, a 4-page brochure describing a method for obtaining synchronized proportioning in processing operations. Applicable for blending oil, feeding additives, and the like. Proportioneers, Inc.

32—Preheating Welds

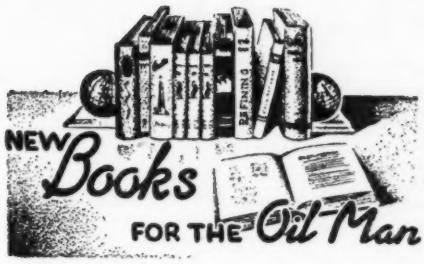
Tempil Topics, Vol. 3, No. 1, is a brief discussion of the importance of preheating in welding operations as a crack preventive measure. Tempil Corp.

33—Neoprene

Neoprene Notebook, No. 39, Dec., 1947, presents data on tests of Neoprene hose in aromatic hydrocarbon service. E. I. du Pont de Nemours & Co., Inc.

For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 265. Just circle the numbers corresponding to the numbers on the items your're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.



Copies of all books reviewed here may be ordered from the Reader's Service Department, Petroleum Processing, 1213 West Third St., Cleveland 13, for the price listed, postpaid, unless indicated otherwise. Ohio purchasers please add 3% tax.

Third Edition of LPG Handbook Includes Valuable Additions

Handbook, Butane-Propane Gases, 3rd Edition, edited by Lynn C. Denny and Harold W. Wickstrom, 8½ x 11½ in., 352 pages, indexed, stiff cloth binding, $5.00. (1947).

This third reprinting of the third edition of the *Butane-Propane Handbook* includes a number of timely and pertinent revisions and additions made since the last previous issue in 1942.

The general subdivisions of the book cover the same topics as previously—history, basic principles, physical and chemical properties, production, transportation and storage, distribution, utilization, and regulations.

A new chapter on "Fire Protection and Control" outlines accepted safety practices in the design and operation of LPG plants and distribution systems. Technical advances in meeting the problems of transportation and storage are covered by a new chapter on methods of liquid metering and pumping. There is also a new chapter on installation and servicing of LPG systems, as well as two on domestic and commercial applications.

Many prominent members of the petroleum industry directly concerned with LPG assisted editors Denny and Wickstrom in the preparation of the current issue of this Handbook.

Fifth in WRU Frontiers Series Covers Chemical Architecture

Frontiers in Chemistry, Vol. 5, Chemical Architecture, edited by R. E. Burk and Oliver Grummitt, 6 x 9 in., 202 pages, stiff cloth binding, illustrated, indexed, $4.50. (1948)

Keeping abreast with advances in science is important to the industrial research man. Too often he tends to work in a narrow, practical field, and loses value as a member of the staff because he is out of touch with the broader aspects of science. He actually becomes obsolete insofar as learning new approaches for attacking his own specific problems.

Chemical Architecture deals with the molecular structure of things and its relationship to a number of important industrial type processes. It is the fifth volume in a series based on the Western Reserve University Frontiers in Chemistry lectures, which were inaugurated in 1942 and designed to help both graduate students and industrial chemists keep up to date. The present volume covers a group of six papers given by experts in their fields during the 1947 program.

Of particular interest to the petroleum industry is the last chapter, "The Nature of Inorganic Gels." by Miroslav W. Tamele, Associate Director of Research and Head of the Department of Colloid Chemistry for Shell Development Co., Emeryville, Calif. Dr. Tamele discusses the structure of gels used as catalysts and catalyst carriers, and their role in catalytic processes. He is the only one of the authors directly connected with industrial research work.

Other chapters also cover the structure of molecules in various conditions and have been written by Dr. Hugh S. Taylor, Chairman of the Department of Chemistry and Dean of the Graduate School, Princeton University; Dr. Charles P. Smyth, Professor of Chemistry at Princeton; Dr. W. Conrad Fernelius, Chairman of the Department of Chemistry, Syracuse University; Dr. Bertram E. Warren, Professor of Physics, Massachusetts Institute of Technology; and Dr. Herman Mark, Director of the Institute of Polymer Research at Polytechnic Institute of Brooklyn.

Editors R. E. Burk, of the Plastics Dept. of E. I. du Pont de Nemours & Co., and Oliver Grummitt, of Morley Chemical Laboratory, Western Reserve University, have ably handled this current volume in the Frontiers in Chemistry series and also the preceding four volumes. A sixth volume is scheduled for publication soon.

New Edition of Safety Directory Continues Pattern Set in 1947

Best's Safety Directory, 2nd Edition, 8¼ x 11 in., 494 pages, stiff cloth binding, illustrated, indexed, $5.00. (1948).

The latest edition of *Best's Safety Directory,* for 1948, continues the same pattern as inaugurated in last year's book. Approximately 50% greater in editorial content, it is a combination safety manual, directory, and catalog. It covers most known manufacturers of equipment for preventing accidents and fires.

Its index, using a subject-classification system, makes it easy for the user to locate products although he may not be certain of the type or the name of the product he needs. Also included are many of the standards established for safety equipment by such organizations as the American Standards Association.

New Plastics Book Represents Comprehensive Literature Review

The Science of Plastics, Vol. I, edited by H. Mark and E. S. Proskauer, 6½ x 9¾ in., 650 pages, illustrated, indexed, stiff cloth binding, $9.00. (1948).

Because of the rapid expansion and growth in the plastics industry and its technology, *The Science of Plastics* will provide effective and efficient aid to the researchers in this and related fields.

It consists of a systematic collection of abstracts and patent data on the most important domestic and foreign papers devoted to the science of plastics and polymers. It is based upon material from the looseleaf "Resins, Rubbers, and Plastics Abstract Service" which was initiated in 1942, and it covers the literature from that time through December, 1946.

The present volume pertains to data on the properties of polymers in the solid state, the behavior of macromolecules in solution, and the mechanism of polyreactions. Papers restricted to studies on single plastics; for example, polystyrene, cellulose, and the like, have been reserved for a second volume, scheduled for early publication.

Publish Bound Volume Covering First Five Years of Project 44

Selected Values of Properties of Hydrocarbons, Circular of the National Bureau of Standards C461, 7¾ x 10¼ in., 496 pages, buckram binding, $2.75. (1947).

The newly published *Selected Values of Properties of Hydrocarbons* represents a complete collection of all numerical tables (as of May 31, 1947) issued during the first five years of the cooperative research program of the American Petroleum Institute and the U. S. Commerce Department's National Bureau of Standards, known as the API Research Project 44.

Following are the properties covered by this study: boiling point, and pressure coefficient of the b.p.; refractive index; density and specific gravity; freezing point; molecular volume; molecular and specific refraction; specific dispersion; refractivity intercept; viscosity; critical constants; P-V-T relations; vapor pressures; heat and entropy of vaporization; heat of combustion; heat content; free energy function; entropy; heat capacity; heat of formation; free energy of formation; equilibrium constant of formation; heat and entropy of fusion; cryoscopic constants; and heat of transition.

The plan of issuing new, current

LUBRICANTS — GAS ANALYSIS
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tables in loose-leaf form on a monthly basis as they are compiled is not affected by the preparation of this bound volume. A second volume is to be published at the end of the second five-year period.

Compilation was by a staff of the Bureau of Standards under the able direction of Dr. Frederick D. Rossini, Chief of the Section on Thermochemistry and Hydrocarbons.

Hydrocarbon Encyclopedia Revised to Jan. 1, 1946

Encyclopedia of Hydrocarbon Compounds, Replacement Sheets No. 2 for Vol. I, C_1—C_3; 171 sheets, 5½ x 8½ in., punched for insertion in the original volume, $5.65.

These 171 sheets have been issued to bring Vol. I of the *Encyclopedia of Hydrocarbon Compounds* up-to-date to Jan. 1, 1946. (The original volume was reviewed in the *NPN Technical Section,* June 5, 1946, pg. R-477.)

Included are 2 sheets of amendments to the introductory matter, a revised list of journals to which references are made, a cumulative name index C_1 through C_9, 62 addition sheets, 59 replacement sheets and 4 correction sheets.

Technical Meetings For Oil Men

March

1-8, American Society for Testing Materials, spring meeting, Statler Hotel, Washington, D. C.

9-10, Commercial Chemical Development Assn., Roosevelt Hotel, New York City.

24-26, Natural Gasoline Assn. of America, annual meeting, Texas Hotel, Ft. Worth, Texas.

April

5-7, Western Petroleum Refiners Assn., annual meeting, Galvez and Buccaneer Hotels, Galveston, Texas.

5-8, National Assn. of Corrosion Engineers, fourth annual conference and exhibition, Jefferson Hotel, St. Louis, Mo.

19-21, American Society of Lubrication Engineers, annual convention, Statler Hotel, Buffalo, N. Y.

19-23, American Chemical Society, 113th annual meeting, Chicago.

21-23, National Petroleum Assn., Hotel Cleveland, Cleveland.

28-30, Liquefied Petroleum Gas Assn., annual convention and trade show, Hotel President, Municipal Auditorium, Kansas City, Mo.

May

4-5, American Gas Assn., Natural Gas Dept., annual spring meeting, Rice Hotel, Houston.

9-12, American Institute of Chemical Engineers, regional meeting, Hollenden Hotel, Cleveland.

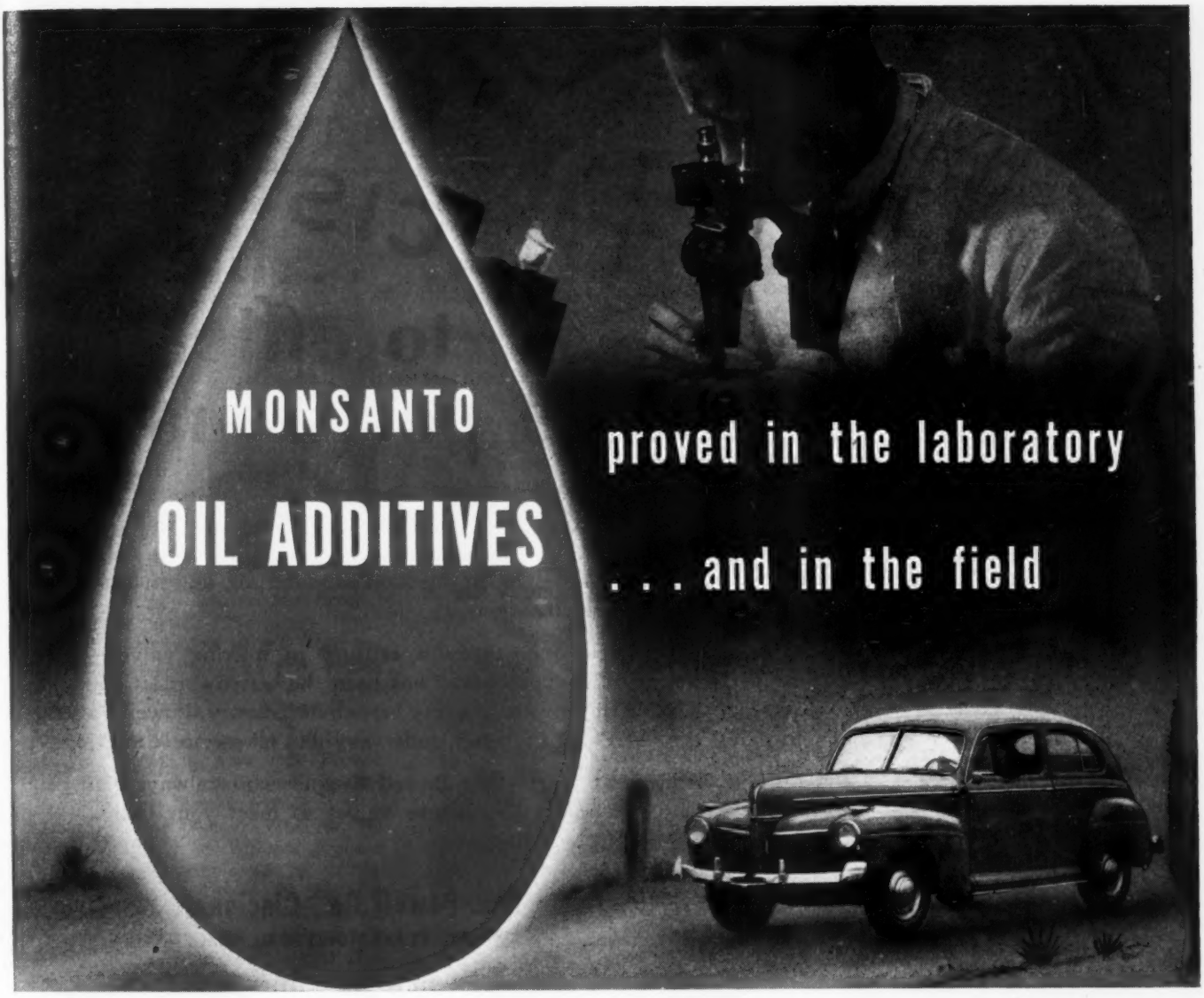
10-13, American Petroleum Institute, Division of Refining, mid-year meeting, Ben Franklin Hotel, Philadelphia.

15-22, International Petroleum Exposition, Tulsa.

June

6-11, Society of Automotive Engineers, semi-annual meeting, French Lick Springs Hotel, French Lick, Ind.

21-25, American Society for Testing Materials, 51st annual meeting, Book-Cadillac Hotel, Detroit.



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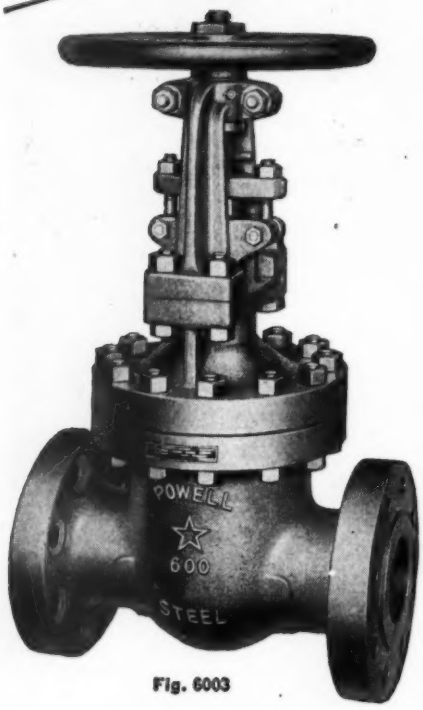


Fig. 6003

Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and taper wedge solid disc.

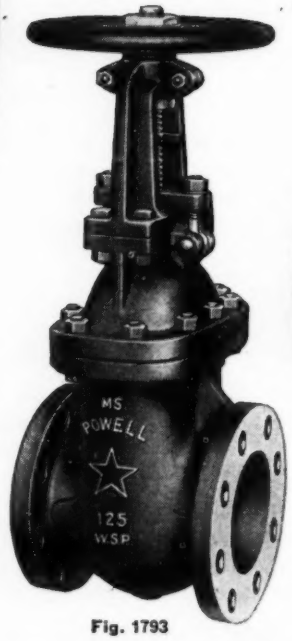


Fig. 1793

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", inclusive. Has outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Also available in All Iron for process lines.

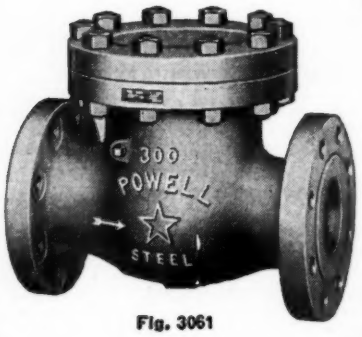


Fig. 3061

Fig. 3061—Class 300-pound Cast Steel Swing Check Valve with flanged ends and bolted cap. Disc has ample lift to permit full, straightway, unobstructed flow through valve body.

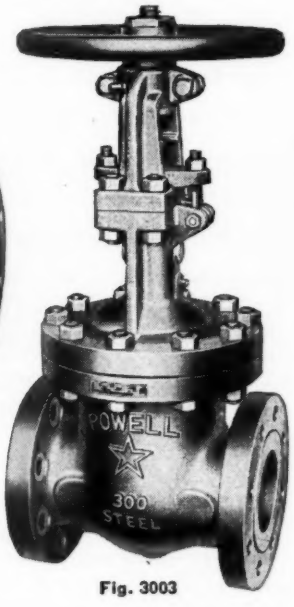


Fig. 3003

Fig. 3003—Class 300-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and taper wedge solid disc.

POWELL VALVES

PERSONALS

PETROLEUM TECHNOLOGISTS IN THE HEADLINES

Philip S. Magruder, vice president and director and manager of the manufacturing department of General Petroleum Corp., has been elected an executive vice president. He joined the company as a tester in 1925, became a gas engineer at Santa Fe Springs, and general superintendent of the gas department at Vernon in 1929. He became manager of the manufacturing department in 1945 and a director of the company the same year and a vice president in 1946.

Mr. Magruder

* * *

Howard Kehde, formerly of Union Oil Co. of Calif., is now with Foster Wheeler Corp. in charge of process engineering of Hypersorption units. Prior to joining Foster Wheeler, he spent four years in Union's process development division assisting in the development of all phases of the Hypersorption process. He also assisted in the direction of the start-up operations of the first commercial Hypersorption unit last May. Mr. Kehde is a graduate of Columbia University.

* * *

Mr. Green

E. L. Green, Jr., executive assistant and head of the natural gas and gasoline department of Cabot Carbon Co., has been elected vice-president. Mr. Green is a Texan who graduated from the University of Texas in 1929. After three years with Gulf Oil Corp., he went with the Texas Railroad Commission, and was supervisor successively of the Panhandle and Gulf Coast Districts. He joined the Cabot Co., in 1936.

* * *

Charles E. Paules is associate chief engineer of Standard Oil Development Co.'s Esso Engineering Dept., responsible to Chief Engineer **Eric W. Luster** for the administration of the department. He was formerly one of three assistant chief engineers. A civil engineering graduate of Lehigh University in 1916, he served in World War I, joined the general engineering department of Standard Oil Co. of New Jersey in 1919 and has held the assistant chief engineer's title since 1936.

* * *

John R. MacGregor, associate director of California Research Corp. of Standard Oil Co. of California, is vice president, fuels and lubricants activity, of the Society of Automotive Engineers for 1948. He secured his BS in mechanical engineering from the University of California in 1923 and joined California Standard as a fuel and lubricant test operator in 1925. He became a member of the staff of the research subsidiary when it was organized in 1944.

* * *

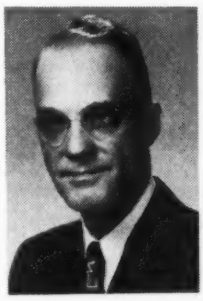
Mr. Bolte

Mr. Carl E. Bolte has been elected to the position of vice-president in charge of sales for the Battenfeld Grease & Oil Corp. During the war Mr. Bolte was a director of the Industrial Service Division of the Smaller War Plants Corporation in Washington, D. C. He was appointed Executive Secretary of the National Lubricating Grease Institute July 1, 1946, a position which he has held since that time.

* * *

Dana S. Mellett, chief engineer of the Trenton (Mich.) refinery of the Socony-Vacuum Oil Company, Inc., has been appointed vice-president of the Mediterranean Refining Company. **E. A. Wilson** has been appointed chief engineer to succeed Mr. Mellett.

* * *



Mr. Chittick

Col. M. B. Chittick, former manager of Pure Oil's specialty & technical sales department goes to the New York office of the American Mineral Spirits Co. as technical director and director of technical sales in the handling of petroleum resins, waxes, and other chemicals derived from petroleum. Col. Chittick, a veteran of both world wars, was deputy chief of the technical division in the office of the chief of chemical warfare in World War II.

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ONE OF THE LARGER independent oil refiners requires the services of several technically trained men experienced in the repair of machinery and processing equipment. Applicants should be under thirty-five years of age and furnish complete outline of technical education, experience, previous employers, salaries received and photograph. BOX 21.

ONE OF THE LARGER independent oil refiners requires the services of several technically trained men experienced in the supervision of modern lubricating oil processing equipment including propane deasphalting, solvent extraction M.E.K. dewaxing and contact filtration. Applicants should be under forty years of age and furnish complete outline of technical education, experience, previous employers, salaries received and photograph. BOX 23.

Business Opportunity

MIDWEST MANUFACTURER of low temperature and other process equipment, essential to the manufacture of synthetic petroleum, is looking for representatives for the Chicago and Kansas City territories. Representatives should have a chemical or mechanical engineering background and have a wide acquaintance in the petroleum industry. Only the highest caliber men or organization will be considered. BOX 22.

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EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

Krug Proposal Means Government Subsidized Liquid Fuel Industry

INTERIOR Secretary Krug's proposal for a $9-Billion synthetic liquid fuels industry, to be created in 5 to 10 years, to supply 2,000,000 b/d of products, means a government peacetime subsidy on a scale not even approached in the wartime aviation gasoline and synthetic rubber plants. A synthetic liquid fuels industry, on a scale and in the manner proposed, would continue to be subsidized and the cost borne by the public indefinitely. Neither the oil companies nor any other private capital could take over these synthetic fuel plants and operate them and sell their products in competition with products made from crude petroleum for many years to come.

The Krug proposal also apparently is based on the premise that coming demands for liquid fuels must be met regardless as to whether or not they represent an economic utilization of such products. The supply difficulties we are experiencing today are the result of demand achieving almost a five-year growth in two years. No one expects this rate of increase in demand to continue.

The largest proportional increases in demand since the war have been for the distillate and fuel oil products and the shortages being experienced today are largely of these products. It is here that the oil industry in the last decade has been assuming more and more of the energy load normally carried by coal. Does Krug propose to build and operate synthetic fuel plants to provide for heating all homes with oil, if the householder so chooses, whether this utilization is economic or not as compared with other uses?

The Krug proposal, it is announced, would require 16,000,000 tons of steel to build the synthetic liquid fuel plants. The shortage of steel since the war is the principal factor that has held the petroleum industry back from further expanding its own supply facilities. Allotted the steel required, and under the normal workings of supply and demand, the industry will overcome the present supply difficulties in far less time than can be done through subsidized synthetic liquid fuel plants. And the public won't wake up to find itself the owner of plants with billions invested in them, built and operated on an unsound economic premise.

The Public's Research Department Presents a Misleading Report

"IT IS anticipated that recommendations can be made during 1948 or 1949 concerning types of retorts suitable for commercial oil-shale operations in the U. S." states the Bureau of Mines annual report on its work in 1947 under the Synthetic Liquid Fuels Act.

However, what little actual cost data is presented doesn't bear out this inference that the economic production of liquid fuels from shale is anywhere near a practicality.

An estimate is given in the report of the cost of mining oil shale on a commercial scale, by underground operations on a 70-ft. thick selected layer yielding 0.7 bbl. of crude oil to the ton. Taking out enough shale to yield 3,500,000 bbls. per year (less than 10,000 b/d) would cost 70c a ton, or $1 a bbl. This includes direct costs and depreciation but no other indirect costs.

The Bureau reports other costs in its work on oil shale but these are for limited experimental operations only. Direct operating cost for crushing the shale is 27c per bbl. Direct operating cost for retorting the crushed shale is 9.6c per gal., $4.03 per bbl. This is based on the operation of only one of the experimental units at the demonstration plant at Rifle, Col. Had the second retort been in operation for the month when the cost data was taken, it is believed the figure would have been below 5c per gal., the report states. The experimental plant operates at the rate of about 50 b/d.

These cost figures are not comparable, since in one case they are estimates for commercial operations and in the other actual figures for pilot-plant work. However, they do not represent a stage of the development work where it can be anticipated that recommendations for equipment and methods for commercial operations may be forthcoming in a few months.

No oil company would announce as even a commercial likelihood an operating project based on the small amount of work and limited data which the Bureau has presented on its work on shale oil to date. Such statements would deceive both management and stockholders. The difference here is that it is the public that is being misled.

Specifications Being Reviewed As Construction Cost Item

PRESENT high construction costs for new units and replacements have led some refiners to review their programs for drawing up specifications for new materials and equipment. Where the company "specs" can be brought into line with those for manufacturers' standard products, important savings in both costs and delivery time result under today's conditions.

The plan of writing company specifications was widely used when special items were not much higher in cost as compared with standard items. Also the manufacturers' standard line has improved in quality and workmanship and is now acceptable where the refiner formerly thought his own specifications had to be drawn to insure meeting operating conditions at his individual plants.

Construction costs may also be increased materially today by building two or more units from one set of blueprints supplied by the refiner. Unless the various units are exactly the same, engineering contractors say, difficulties may be caused for the fabricator or erector that will more than offset the saving the refiner's engineering department made by preparing only one set of drawings.

READERS' Comments and opinions will be welcomed by the editors of PETROLEUM PROCESSING, 1213 West Third Street, Cleveland 13, Ohio

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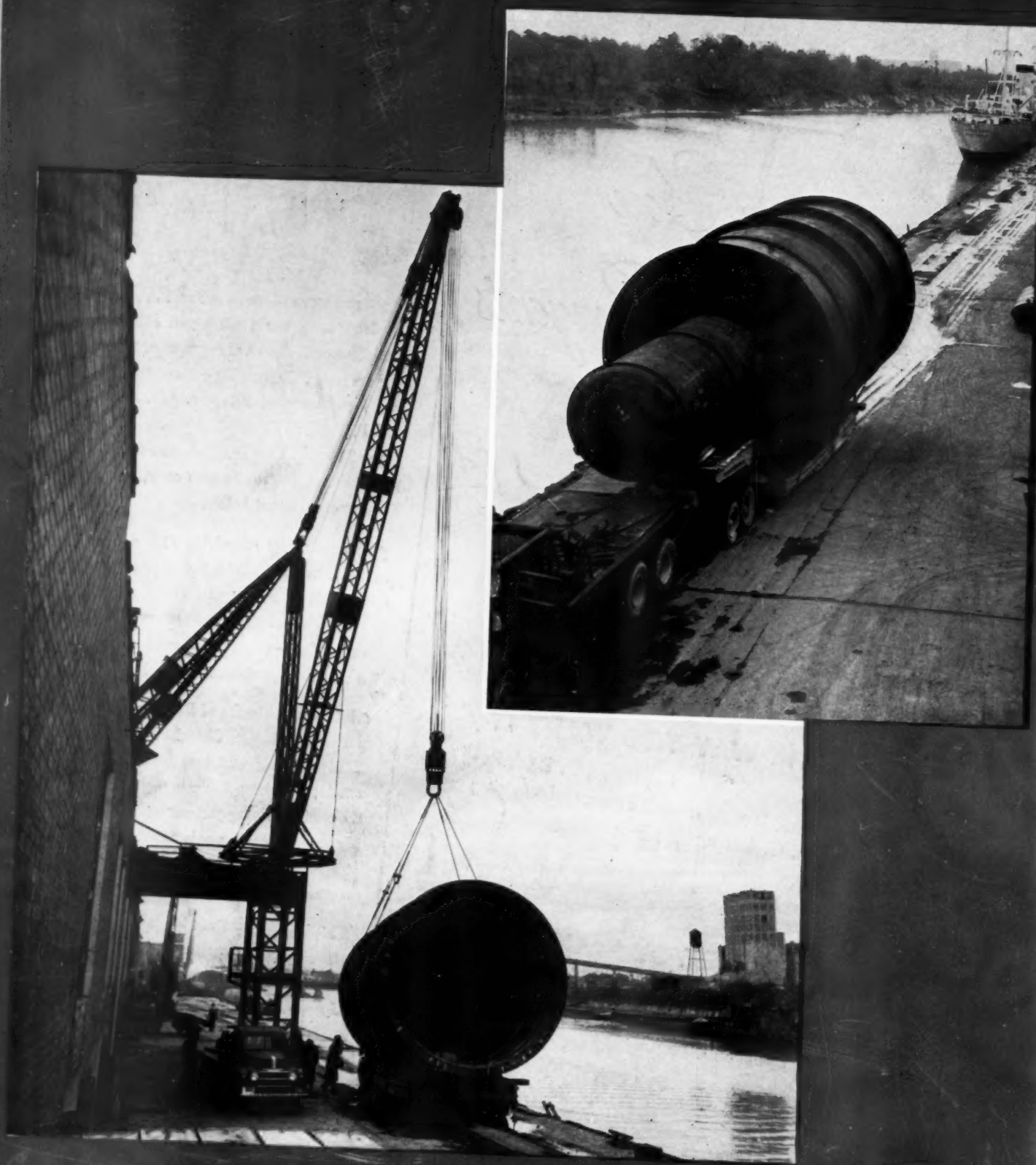

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